TO EVALUATE THE OUTCOME OF ENDOVASCULAR COILING IN PATIENTS WITH RUPTURED INTRACRANIAL ANEURYSMS

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Dedicated

to

my Grand

Parents

&

Parents

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Dr. Saurav Mittal

LIST OF ABBREVIATIONS

SAH	Subarachnoid Haemorrhage
IA/UIA	Intracranial aneurysms/ Unruptured intracranial aneurysms
MRA	Magnetic resonance angiography
CT	Computed tomography
GDC	Guglielmi detachable coil
DSA	Digital subtraction angiography
GOS	Glasgow outcome scale
mRS	modified rankin scale
RR	Relative risk
CI	Confidence interval
Acom	Anterior communicating artery
MCA	Middle cerebral artery
ACA	Anterior cerebral artery
ICA	Internal carotid artery
PCA	Posterior cerebral artery
Pcom	Posterior communicating artery
VA	Vertebral artery
BT	BleedingTime
CT	ClottingTime
DLC	Differential Leukocyte Count
DSP	Differential Serum Proteins
ECG	Electrocardiography
FBS	Fasting Blood Sugar
GA	General Anaesthesia
Hb	Haemoglobin
HBsAg	Hepatitis B Surface Antigen
HCV	Hepatitis C Virus
HIV	Human Immunodeficiency Virus
PTI	Prothrombin Time
SGOT	Serum Glutamicoxaloacetic Transaminase

SGPT	Serum Glutamic Pyruvic Transaminase
TLC	Total Leukocyte Count
TSP	Total Serum Proteins
WBC	White Blood Cells
IV	Intravenous
CSF	Cerebrospinal fluid
EVD	External ventricular drainage
VP shunt	Ventriculoperitoneal shunt
GCS	Glasgow coma score
Op	Operative
GDC	Guglielmi detachable coil
EC	Endovascular coiling
FD	Flow diverter

ABSTRACT

INTRODUCTION: Intracranial aneurysms are a common condition affecting nearly 3.2% of the adults (mean age of 50 years) population globally.Aneurysmal Subarachnoid Haemorrhage (aSAH) which commonly occurs due to rupture of intracranial aneurysms is life-threatening and requires prompt medical treatment. With the development of technology, endovascular coiling has become the first line treatment method for intracranial aneurysms.

AIM OF THE STUDY: To evaluate the outcome of endovascular coiling in patients with ruptured intracranial aneurysms.

METHODS: A hospital based prospective observational study was conducted in Department of Neurosurgery, Dayanand Medical College and Hospital, Ludhiana over a period of 15 months. 48 patients with ruptured intracranial aneurysms underwent endovascular coiling. Clinical outcomes were assessed by using Glasgow outcome scale.

RESULTS: Among 48 patients who underwent endovascular coiling for ruptured saccular intracranial aneurysm, 34 (70.9%) had good clinical outcome (Glasgow coma score 4 ,5). Mean age group was 54.38 years with slightly higher female predominance(52.1%). Hypertension was found to be most common risk factor for rupture of aneurysm(64.6%).6 patients (8.3%) developed post operative hydrocephalus for which they underwent CSF diversion.

CONCLUSION: Endovascular coiling has widely been accepted as a treatment of ruptured intracranial aneurysms. It facilitates overall good outcomes in patients after subarachnoid haemorrhage.

KEYWORDS: Subarachnoid haemorrhage; Intracranial aneurysms; Endovascular coiling;outcomes.

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INTRODUCTION

An intracranial or cerebral aneurysm refers to abnormal focal dilation of an artery in the brain resulting from weakening of the inner muscular (the intima) of a blood vessel wall. A "blister-like" dilatation forms in the vessel, which may suddenly thin out and rupture. It may result in bleeding into the subarachnoid space and is called subarachnoid haemorrhage and sometimes it may cause bleeding into the brain tissue which is called intracerebral haemorrhage. A stroke, vegetative state and/or death may result from this type of haemorrhage. Aneurysmal Subarachnoid Haemorrhage (aSAH) which commonly occurs due to rupture of saccular aneurysms accounts for an estimated 5-15% of all strokes [1]

Brain aneurysms are typically acquired lesions which may be brought by, various atherosclerotic changes, congenital defects in blood vessel wall, trauma or an infectious emboli. A few medical conditions, including fibromuscular dysplasia, autosomaldominant polycystic kidney disease, and connective tissue disorders including Ehlers-Danlos and Marfan syndrome, have been observed to have an increased incidence.

Most of the intracranial aneurysms are silent and may be found incidentally on neuroimaging. Currently, magnetic resonance angiography (MRA) is advised for the screening of aneurysms in patients with autosomal dominant polycystic kidney disease [2] .A family history of brain aneurysm especially in the first degree relatives accounts for increased risk of harbouring a brain aneurysm. Although less than 2% of brain aneurysms are familial [3], MRA screening should be performed in first-degree relatives of aneurysm patients [4]

Anterior circulation contains about 85% of aneurysms, predominantly at layer junctions or bifurcations along the circle of Willis.[5]
Only 0.5% to 4.6% of all aneurysms occur in children under the age of 18 and their epidemiology is not well studied in literature.[6] With

regards to gender, males are more likely to have intracranial aneurysms than females, with the ratio being 2:1, which may point towards the different underlying mechanisms leading to aneurysmal occurrence.[7] An explanation underlying this trend is that environmental variables might contribute to the higher occurrence in females, whereas inherited factors, which are present in all aneurysm patients, may be more contributory in males.

Intracranial aneurysms are a common condition affecting nearly 3.2% of the adult (mean age of 50 years) population globally.[8,9] Over the last 15 years, neurosurgery has grown rapidly in India, and several neurological procedures are being attempted.

A ruptured aneurysm quickly becomes life-threatening and requires prompt medical treatment. Considering the annual incidence of aneurysmal SAH between 6 and 16/100,000 population [10], about 76,500-204,100 new cases occur in India each year

In the United States, up to 6% of people may have an unruptured cerebral aneurysm, while over 30,000 patients experience a ruptured cerebral aneurysm each year [11]. The prevalence of intracranial aneurysm is about 1-5% (10 million to 12 million persons in the United States) and the incidence is 1 per 10,000 persons per year in the United States, with 30 to 60 year old being the age group most affected.[12]

RISK FACTORS FOR ANEURYSM FORMATION [13]

Various risk factors are associated with formation of aneurysm. These include:

- Age: Aneurysms are more commonly diagnosed in individuals who are over the age of 40.
- Sex: Women are likely to get more aneurysms than men.
- Family history of aneurysm.
- Hypertension
- Smoking

- Alcohol and drug misuse, specifically cocaine or amphetamine use.
- Head injury
- Genetic conditions including Autosomal dominant polycystic kidney disease, Ehlers- Danlos syndrome, Marfan syndrome
- Congenital conditions like arteriovenous malformations or coarctation of aorta can also raise the risk of aneurysm formation.

RISK FACTORS FOR ANEURYSM RUPTURE [14]

Various risk factors that can raise the likelihood of an aneurysm rupture are:

- Smoking
- Hypertension
- Size: The most probable aneurysms to rupture in a person who had no symptoms before are the biggest ones.
- Location: Compared to aneurysms at other places in the brain, those on the posterior communicating arteries and potentially the anterior communicating arteries are more likely to rupture.
- A family history of aneurysm rupture suggests a higher risk of rupture for aneurysms detected in family members.
- Presence of multiple aneurysms in individuals who have previously experienced a rupture or sentinel bleed are at the highest risk.

SYMPTOMS

The symptoms and warning signs of brain aneurysm vary, based on whether it has ruptured or not.

SYMPTOMS OF RUPTURED ANEURYSM [15]

- Sudden and severe headache (the worst headache of one's life, sometimes called thunderclap headache)
- Neck stiffness
- Blurring of vision/ double vision

- Increase sensitivity to light
- Drooping eyelid
- Difficulty in speaking
- Dizziness or trouble walking
- Nausea or vomiting
- Seizures
- Mental confusion
- Loss of consciousness

CLASSIFICATION OF ANEURYSMS [16]

I. According to size, Aneurysms are classified as:
   A. **Small Aneurysms**: less than 11mm in diameter
   B. **Large Aneurysms**: 11-25mm in diameter
   C. **Giant aneurysms**: greater than 25mm in diameter

II. Based on the type, there are three types of cerebral aneurysms:
   A. Saccular Aneurysm
   B. Fusiform Aneurysm
   C. Mycotic Aneurysm

COMPLICATIONS OF RUPTURED CEREBRAL ANEURYSM [17]

When the aneurysm leaks or bursts open, blood flows into or around the brain. The pooling blood irritates brain tissue, which can make the brain swell. The result can be permanent brain damage, stroke or other complications such as:

- Vasospasm
- Hydrocephalus
- Rebleeding
- Hyponatremia
- Seizures
- Coma
- Arrythmias
- Congestive cardiac failure

DIAGNOSTIC MODALITIES

Improvements in imaging have led to a greater number of aneurysms being discovered prior to rupture. To diagnose brain aneurysms and choose the best course of therapy, a number of tests are available. These include:[18]

- Computed tomography/ CT angiography
- Magnetic resonance imaging[MRI]
- Magnetic resonance angiography [MRA]
- Digital subtraction angiography[DSA]
- Lumbar puncture

Thus intracranial aneurysms warrant for early diagnosis and early intervention so as to prevent further complications.

AIMS AND OBJECTIVES

To evaluate the outcome of endovascular coiling in patients with ruptured intracranial aneurysms.

REVIEW OF LITERATURE

In 1979 Russian neurosurgeon Fedor Serbinenko described his experience with endovascular procedures that included balloon embolization of aneurysm . He used his kitchen table to make balloons. Balloon embolization emerged as the preferred treatment for brain aneurysms that were otherwise incurable in the 1980s. But the outcomes were not good. In 1988, Dr. Guido Guglielmi joined Dr. Fernando Vinuela at the “University of California”, Los Angeles and the two of them started working together on the GDC. The first patient was treated with GDC at the UCLA Medical Centre in March 1990. The GDC was approved by the Food and Drug Administration (FDA) in 1995.In 1997, Balloon remodelling, also known as balloon-assisted coiling, was used to assist coiling of broad neck aneurysms. The FDA approved the “Neuroform stent”, an endovascular remodelling device, in 2003 under the Humanitarian device exemption (HDE) for the treatment of wide neck aneurysms, thus further expanding the indications for endovascular aneurysm therapy.

Additional device for wide-neck aneurysms was added in 2006 when the HDEFDA approved the “Enterprise stent”, another endovascular remodelling device. In 2008, the first liquid embolic device for a specific class of difficult wide neck aneurysms was approved by the HDEFDA for the “ONYX HD 500” (Covidien, Dublin, Ireland). In 2011 the FDA approved Pipeline, a flow-diverting device, adding another weapon to the arsenal for treating fusiform aneurysms and wide neck aneurysms. The “Pipeline device” (Covidien, Dublin, Ireland) is a flexible stent having thick strut pattern. The last ten years have seen the emergence of new coil manufacturers with 3D, 2D, and 360-degreeshapes and coil designs; varying degrees of softness; coatings required in bioreactivity with Matrix coils (Stryker, Kalamazoo, MI); and volume expanders with Hydrocoils (Microvention Inc., Tustin, CA).The length of endovascular treatments has been directly impacted by technological breakthroughs made by several firms in coil detachment time. [19]

In 2001, the International Subarachnoid Aneurysm Trial compared the results of outcomes in patients with ruptured intracranial aneurysms treated with either surgical clipping or endovascular coiling. A total of 2,143 patients received treatment and were assigned at random. The observations of this trial were that endovascularly coiled patients had better outcome.[20] The Barrow Ruptured Aneurysm Trial (BRAT) has confirmed the superiority of endovascular coiling over the surgical clipping [21]

OUTCOME

For practical purposes it is essential to have a limited number of exclusive outcome categories, accepting that some will include patients with a range of different degrees of disability. The Glasgow Outcome Scale was first described in 1975 by Bryan Jennett and Michael Bond as means to access both survival and quality of life following brain injury. This scale reflects disability and limitations in major areas of life instead of focusing on specific impairments.[22]. The assessment is conducted in interview format, assessing consciousness level, independence in activities of daily living (ADLs), independence outside the home, ability to work, ability to participate in social or leisure activities, and extent of adverse impact on relationships with others.[23,24]

- Score 1: Death
- Score 2: Persistent vegetative state
- Score 3: Severe disability
- Score 4: Moderate disability
- Score 5: Good recovery

GRADING[25]

- In 1956, Botterell and Cannell published the first commonly used scale for neurological conditions following SAH, which they called the Botterell Grading Scale. This was modified by Hunt and Hess in 1968.

- The **Fisher and modified Fisher grade** categorizes on basis of amount of SAH on CT head scan.
- The **World Federation of Neurosurgeons (WFNS) classification** includes **Glasgow coma score** and focal neurological deficit to access the severity of symptoms.

Table 1: "HUNT AND HESS" SCALE[26]

HUNT AND HESS SCALE		
GRADE	SYMPTOMS	SURVIVAL
GRADE I	• ASYMPTOMATIC / MINIMAL HEADACHE WITH SLIGHTNUCHALRIGIDITY	• 70% SURVIVAL
GRADE 2	• MODERATE TO SEVERE HEADACHE; NECK STIFFNESS; NO NEUROLOGICAL DEFICIT EXCEPT CRANIAL NERVE PALSY	• 60% SURVIVAL
GRADE 3	• DROWSY; MINIMAL NEUROLOGICAL DEFICIT	• 50% SURVIVAL
GRADE 4	• STUPOR; MODERATE TO SEVERE HEMIPARESIS; POSSIBLY EARLY DECEREBRATE RIGIDITY AND VEGETATIVE DISTURBANCES	• 20% SURVIVAL
GRADE 5	• DEEP COMA; DECEREBRATE RIGIDITY; MORIBUND	• 10% SURVIVAL

Table 2: FISHER SCALE [27]

FISHER SCALE		
GRADE	SYMPTOMS	INCIDENCE OF SYMPTOMATIC VASOSPASM:
GRADE 1	NO SUBARACHNOID (SAH) OR INTRAVENTRICULARHEMORRHAGE (IVH) DETECTED	INCIDENCE OF SYMPTOMATIC VASOSPASM: 21%
GRADE 2	• DIFFUSE THIN (<1 MM) SAH • NO CLOTS	INCIDENCEOF SYMPTOMATIC VASOSPASM: 25%
GRADE 3	• LOCALIZED CLOTS AND/OR LAYERS OF BLOOD >1 MM IN THICKNESS • NO IVH	INCIDENCE OF SYMPTOMATIC VASOSPASM: 37%
GRADE 4	• DIFFUSE OR NO SAH • ICH OR IVH PRESENT	INCIDENCE OF SYMPTOMATIC VASOSPASM: 31%

Table 3: MODIFIED FISHER SCALE[27]

MODIFIED FISCHER SCALE		
GRADE	CT FINDINGS	INCIDENCE OF SYMPTOMATIC VASOSPASM:
GRADE 0	• NO SUBARACHNOID HEMORRHAGE (SAH) • NO INTRAVENTRICULAR HEMORRHAGE (IVH)	• 0%
GRADE 1	• FOCAL OR DIFFUSE, THIN SAH • NO IVH	• 24%
GRADE 2	• FOCAL OR DIFFUSE, THIN SAH • IVH PRESENT	• 33%
GRADE 3	• THICK SAH • NO IVH	• 33%
GRADE 4	• THICK SAH • IVH PRESENT	• 40%

Table 4: WORLD FEDERATION OF NEUROSURGEONS (WFNS) CLASSIFICATION[28]

GRADE	GLASGOW COMA SCORE
GRADE I	GCS 15
GRADE II	GCS 13-14 WITHOUT FOCAL NEUROLOGICAL DEFICIT
GRADE III	GCS 13-14 WITH FOCAL NEUROLOGICAL DEFICIT
GRADE IV	GCS 7-12
GRADE V	GCS 3-6

TREATMENT FOR BRAIN ANEURYSMS

Surgery is the definitive treatment for ruptured intracranial aneurysms. There are two treatment options

1. Open surgical clipping
2. Endovascular coiling

1. Open Surgical clipping

It was first performed by Walter Dandy in 1937.It involved a craniotomy. After microscopic dissection, a clip was placed across the aneurysm neck, preventing arterial blood from entering it.

2. Endovascular coiling:

Was originally developed by Dr Fernando Vinuela and Guido Gugielmi at the UCLA Medical Centre.

(A) Balloon-Assisted Coiling: In this procedure coiling is done in combination with a tiny balloon catheter which helps in holding coils in place.

(B) Combination of Stent and Coiling: In this procedure coiling is done in combination with a stent (a small flexible cylindrical mesh tube) and or flow diverter that provides a scaffold for the coil mass. This technique is very important for the management of wide neck and fusiform aneurysms

Goals of endovascular coiling:[29]

1. Isolating and tightly packing of an aneurysm from the normal circulation without obstructing any small arteries nearby or main vessel
2. Prevention of rupture
3. Prevention of rebleeding in ruptured aneurysms by decreasing blood circulation to the aneurysm.

The patients most suitable for endovascular coiling are those with aneurysms:[30]

1. With a small neck size (preferably <4mm)
2. With Luminal diameter <25mm
3. That are distinct from the parent vessel

MECHANISM:

Endovascular coiling works by promoting blood clotting (thrombosis) in the aneurysm, which seals it from the blood flow. This is accomplished by decreasing the amount of blood flow going into the aneurysm, increasing the residence time of the blood in the aneurysm space and reducing the wall shear stress of the aneurysm wall.[31]

Elewa MK conducted a study on patients who had underwent endovascular coiling for symptomatic and asymptomatic cerebral aneurysm between 2011-2016 in Suez insurance hospital. 35 aneurysms in 31 cases were included in this study. Both males and females were equally distributed. The age range was from 18-71 years, mean age was 45.7 ± 13 years and hypertension was found to be most prevalent risk factor in 13 patients (41.9%). 30 patients(96.8%) were symptomatic. Symptomatic patients either presented with subarachnoid haemorrhage [28 patients (90.3%)] or with mass effect [2 patients (6.5%)]. Only one patient was found to be asymptomatic. According to Hunt and Hess scale, 10 patients (32.2%) were of grades 1 and 2, and on the other hand 21 patients (67.8%) were of grades 3 and 4. According to Fisher grading, 22 patients (71%) were at grades 1, 2 and

9 patients (29%) were at grades 3 and 4. Vasospasm related infarction was present among five patients (16.1%) and five patients (16.1%) developed hydrocephalus for which they had to undergo shunting. Good outcome (mRS= 0, 1, 2) was present among 23 patients and 8 patients had poor outcome (mRS= 3, 4, 5, 6).Two patients died in the study post operatively before discharge because of chest infection and pulmonary embolism. Multivariate analysis showed that Hunt and Hess scale, admission mRS, Fisher grading, vasospasm-related infarction, and hydrocephalus necessitating shunt had a significant association with poor outcome. He concluded that the endovascular coiling could be used as a first-choice option for treatment of saccular cerebral aneurysms [32]

In another study, 3-year retrospective analysis was performed by Ahmad S to evaluate the clinical and radiological results of cerebral aneurysm patients treated with detachable coils in an Asian population in relation to concomitant conditions such as hypertension and smoking, using age and gender as mediating factors. The study included 297 consecutive patients in total. The study employed a modified Rankin scale to assess patients' clinical outcomes. Male and female patients were distributed almost evenly throughout the study, with the majority of patients (57.6%) being female. The bulk of the patients were between the ages of 40 and 50, with an average age of 42. It was found that smoking was associated with poor clinical outcome, as smokers in 35%; they had a lower chance of recovery, although hypertension only contributed 15%. Due to comorbidities, individuals over 40, regardless of gender, had a decreased likelihood of recovery compared to younger patients.[33]

A 6-year study was conducted by Sharma DP, Singh D, Jagetia A, et al on 150 patients (77 males and 73 females). 168 aneurysms were coiled in 150 patients with the mean age 47 years. Eighteen of the patients had incidental unruptured aneurysms. The size of the aneurysm among the treated aneurysms was: medium (7-10mm) in

80(49%), large (12-15mm) in 45(26%), small (3-6mm) in 26(15%) and giant (>25mm) in 17(10%) patients.[34]

The study done by Tian Z, Liu J, Zhang Y, et al in the year 2014-2015 included 504 patients (219 males and 285 females) with 558 intracranial aneurysms. The mean age of the patient was 52.5+/-10.7 years. Out of total 558 aneurysms, 228 (40.9%) were ruptured and 330(59.1%) were unruptured. A total of 94 (16.8%) aneurysms had irregular shape. 260 (46.6%) aneurysms were treated by coiling alone and 298 (53.4%) aneurysms needed stent assisted coiling. Out of 558 aneurysms, 405 (72.6%) were found in the anterior circulation and 153 (27.4%) in the posterior circulation. 57/558 aneurysms showed recurrence. Aneurysm size (p= 0.028), therapy (p=0.008), the Raymond scale (p=0.040), aneurysm rupture status (p <0.001) showed significant associations with angiographic follow-up outcome.[35]

Alizada M, Fuyi Y, Mbori NJR, et al conducted a retrospective study in which 200 patients were randomly divided into two groups, Group A were treated with surgical clipping and Group B were treated with endovascular coiling with female predominance (63%). Patients were evaluated pre-operatively with Hunt and Hess grade and Glasgow coma score. Based on the modified Rankin score, the clinical outcome for endovascular coiling was 73(73%) patients had good outcome, 22(22%) patients showed dependency and 5(5%) death.[36]

Park JH, Kim YI and Lim YC conducted a retrospective study in 2014 using the medical records of 159 elderly patients from September 2008 to December 2013. Clinical information was obtained which included sex ,age, Hunt and Hess grade (HHG), aneurysm location, Fisher grade (FG) and the treatment modality.108 patients (67.9%) presented with subarachnoid haemorrhage (SAH) in case of ruptured aneurysms , and 51 (32.1%) with unruptured intracranial aneurysms (UIAs).101 patients underwent coiling and clipping was done in 58 patients. In patients with SAH , 62 patients (57.4%) had favourable outcomes, with

a mortality rate of 11.3% (n = 18). In the UIAs population, 50 (98%) patients had 'excellent' and one (2%) had 'good' outcome. Factors including high-grade HHG ($p < 0.001$), advanced age ($p = 0.014$), and the presence of intraventricular hematoma (IVH) ($p = 0.017$) were significant factors of poor outcome [37]

Pyysalo LM, keski-Nisula LH, Niskakangas TT et al conducted a study in which clinical outcome of patients with endovascularly treated aneurysms was analysed. Most of the patients with SAH were in good clinical condition after follow-up: 34 (57%) patients had a GOS score of 5, and 12 (20%) patients had a GOS score of 4. Thirteen patients (22%) were dependent (GOS score of 3) and one (2%) patient was vegetative. A total of 31 (55%) patients with unruptured intracranial aneurysms had a GOS score of 5, and 16 (29%) patients had a GOS score of 4. Nine patients (16%) were found to be dependent on follow-up after 11 years. Two patients with unruptured aneurysms didn't follow up.[38].

In another study by Xavier AR, Abdelbaky A, Rayes M et al on "Clinical and angiographic outcome in patients with completely occluded intracranial aneurysms by endovascular coiling" encouraging results were observed. Among 74 patients in which 15 were men and 59 were women with average age 52.4 years, Following intervention , 83 aneurysms with total occlusion were found. Seventy-three aneurysms were treated with coiling alone, and 10 cases involved stent-assisted coiling. Clinically, eight of the 74 patients had moderate disability (GOS score 4), one was severely impaired (GOS score 3) whereas 65 of the patients had good recovery (GOS score 5) [39].

In a study conducted by Sharma N and Sharma MS outcome was noted in patients with ruptured Intracranial Aneurysm treated by endovascular embolization. Most of the patients were in the age group of 40-50 (36%) followed by 50-60 (28%), 30-40 (20%) and >60 (12%) Males formed predominant group i.e. 68% followed by Female 32%.

The common symptoms associated were Headache in 76% (most common) followed by, Vertigo in 68%, Seizure In 44%, Tinnitus in 36%, Blurring of vision in 32%, Difficulty in speaking in 20% and Photophobia In 12%. 48% patients had GCS in 9-12, followed by 28% with GCS 12-15, 16% with GCS 6-9 and in 8% with GCS 3-6. The average Fisher grade was 13± 3.21, Modified Rankin Scale was 14.32± 2.91, Hunt and Hess Classification was 12.89 ± 3.92.[40]

A study was conducted by Herchel Clarke on Management of cerebral aneurysms by endovascular technique at Chris Hani Baragwanath Academic Hospital. This study had 77 patients in total. The patients were 47 ± 11.6 years old on average, and the male to female ratio was 1:1.8. For 27% of individuals, hypertension was the most commonly stated risk factor. Overall, the most prevalent aneurysms were ACom artery (22%) aneurysms. The location with the lowest frequency was basilar tip aneurysms (2%) in this group. No statistical relevance was observed in relation to location of cerebral aneurysms by gender. There was also no statistical correlation between the gender groups according to presentation, multiplicity, aneurysmal size dimensions and locations.[41].

Feiyun qin et al conducted a study on “Endovascular Treatment of Ruptured Very Small Intracranial Aneurysms” in 2022. 152 patients with 152 ruptured intracranial aneurysms were included in this study. 98 (64.5%) were women. The mean age of patients was 56.2 ± 11.2 years and the mean size of the aneurysms was 2.6 ± 0.4 mm (range 1.5–3.0). Out of total 152 patients, 62 (40.8%) underwent Stent assisted coiling, while 90 (59.2%) were treated with coiling alone and one underwent balloon-assisted coiling. Hypertension was prevalent among 73% of total cases. In the study various influential factors were analysed related to the preoperative complications, aneurysm recurrence, and clinical outcomes .The incidence of favourable clinical outcomes (Glasgow Outcome Scale score ≥ 4) at discharge was 86.2% and on follow-up was 97.1%, respectively. It concluded that the

preoperative Hunt-Hess grade, CT Fisher grade, and perioperative complications were risk factors for poor clinical outcomes.[42]

Orz, Yasser, and Mahmoud Al Yamany conducted a study on “The impact of size and location on rupture of intracranial aneurysms.” 81 patients with 104 aneurysms were diagnosed, out of which 45 were males (55.5%) and 36 were females (44.5%). Seventy-six patients (94%) presented with subarachnoid haemorrhage (SAH) due to ruptured aneurysm. In thirty-three patients with SAH (43%), ruptured aneurysm was located at the anterior communicating artery (Acom) with a mean size 5.8 mm. Most of the small (<7 mm) ruptured aneurysms were present at the anterior communicating artery in 51%, distal anterior cerebral arteries in 13%, posterior communicating arteries in 11% and internal carotid artery (ICA) bifurcation 11% . They concluded that both aneurysm size and location play a substantial role in determining the risk of rupture. The most common site of rupture of small aneurysms was the Acom artery, while the middle cerebral artery (MCA) was the commonest site for small unruptured aneurysms [43].

Maud A, Rodriguez GJ, Barboza MA described their experience on endovascular treatment of intracranial aneurysms in 2014. 45 intracranial aneurysms were treated with endovascular embolization. The mean age in the study was 57 years (range 35–92 years) and 73% patients were women (*n* = 33). The most common associated comorbidities present were arterial hypertension (44%), diabetes mellitus (15%), dyslipidaemia (9%), and chronic obstructive pulmonary disease (6%). Most commonly treated IA were located in the anterior circulation MCA (26%), internal carotid artery (22%), and posterior communicating artery (20%) in case of ruptured aneurysm. The mean aneurysm diameter was 8.5 mm (2.5–28 mm), for the ruptured group the mean diameter was 7.1 mm. Regarding the severity of the SAH, 45% patients with ruptured aneurysm that underwent endovascular treatment had a Hunt and Hess grading score equal or less than 3 and

70% of the patients had a Fisher scale equal or less than 3. They concluded that the cerebral aneurysms can be successfully managed with endovascular embolization. [44]

Sedat J, Dib M, Lonjon M, Litrico S, Von Langsdorf D, Fontaine D, Paquis P. conducted a study in which patients aged 65 years and older. 52 patients aged 65 to 85 years (mean age, 71.5+/-4.7 years) were embolized by using GDC (group I). 143 patients with ruptured intracranial aneurysms who were younger than 65 (mean age: 47+/-11 years) received the same treatment (group II). Using the Hunt and Hess (HH) categorization at admission and the Glasgow Outcome Scale (GOS) in the twelfth month, a clinical evaluation was conducted, with arteriographic control in months three and twelve. In group 1, 23% of patients died, while 48% of patients had a favourable outcome (GOS 1 or 2). There was no evidence of rebleeding. More than 77% of patients with lesions larger than or equal to 10 mm had an adverse outcome. In group 2, 14% of cases had a fatality rate and 77% of cases had a favourable outcome (GOS 1 or 2). Upon admission, patients with HH grades of 1 or 2 demonstrated a favourable outcome. In the study the main risk factor and preexisting illnesses was hypertension (52%) and diabetes (4%). Aneurysm responsible for subarachnoid haemorrhage was situated in anterior circulation (94.5%) most commonly located at Acom (44.2%). Aneurysm <10mm represented 75% of treated lesions. It was deciphered that endovascular management of ruptured intracranial aneurysms in patients aged > or =65 years was efficient against rebleeding and represents an alternative to surgery. [45]

Rinkel GJ et al. conducted a study to determine the prevalence and risk of rupture of intracranial aneurysms. The prevalence was found to be 3.6% for retrospective autopsy studies, 3.7% for retrospective angiography studies, 6.0% for prospective angiography studies, and 0.4%for retrospective autopsy studies. In persons without any particular risk factors the prevalence was 2.3%, and it increased with

advancing age. The annual risk for rupture was 1.9%.Women were at increased risk (RR, 2.1[1.1 to 3.9]), as were aneurysms in the posterior circulation (RR, 4.1 [1.5 to 11]), >10 mm (RR, 5.5 [3.3 to 9.4]), or symptomatic (RR, 8.3 [4.0 to 17]). As a result, the great majority of these aneurysms were tiny (=10 mm) and had a 0.7% yearly rupture risk.[46]

Watanabe D, Hashimoto T, Koyama S, Ohashi HT, Okada H, Ichimasu N, Kohno M. conducted a retrospective study on endovascular management in patients with ruptured intracranial aneurysms. In patients 70 years of age and older, 162 patients with 183 cerebral aneurysms received endovascular treatment in a hospital. Of these, 51 patients (31.5%) who had an aneurysm rupture were 70 years of age or older. Two patients had Hunt and Hess (HH) rating of V, seven had HH grade of I or II, and forty-two with HH grade of III or IV. 32 full occlusions (62.7%), 15 neck remnants (22%), and 4 body fillings (7.9%) were the outcomes of endovascular treatment. There were five individuals (9.8%) who experienced procedural problems. 17 individuals (33.3%) had good or outstanding results. An HH grade of IV or V was present in three individuals (5.8%) who passed away. One patient experienced rebleeding during follow-up (1.9%).In the study most aneurysms were found in anterior circulation (74.4%) out of which 47% were on ACA and 14% on ICA. 50 aneurysms(98%) had size less than 12 mm and only 1 had size ranging from 12-25mm. They came to the conclusion that cerebral aneurysm coil embolization is safe and effective in the elderly. However, the morbidity and mortality rates are higher in patients with high HH grades. [47]

Viñuela F, Duckwiler G, Mawad M. conducted a study to evaluate clinical and perioperative anatomical outcome .403 Patients were evaluated until they died or were released from the hospital after receiving treatment within 15 days of the initial cerebral haemorrhage. Thirty percent of the patients were men and seventy percent were women. The average age of the patients was 58. Aneurysm size was

classified as small (60.8%), large (34.7%), and giant (4.5%). Neck size was categorized as small (53.6%), wide (36.2%), fusiform (6%), and undetermined (4.2%). The posterior circulation had 57% of the aneurysms, while the anterior circulation contained 43%. Hunt and Hess Grade I (20.3%), Grade II (26.1%), Grade III (30%), Hunt and Hess Grade IV (17.1%), and Grade V (6.5%) were given to eighty-two patients. The findings of this study demonstrated the safety of the Detachable Coiling system in management of ruptured intracranial aneurysms in anterior and posterior circulations.[48]

Bracard S, Lebedinsky A, Anxionnat R, Neto JM, Audibert G, Long Y, Picard L. published a study on endovascular management of aneurysms in patients with Hunt and Hess grade IV and V . Eighty patients were admitted to the hospital between October 1992 and October 1998 with subarachnoid haemorrhage of Hunt and Hess grade IV and V aneurysms. Of the 80 patients, 42 (52.5%) did well with Glasgow Outcome score of 1 or 2(62% of the 56 patients with grade IV and 25% of the 24 patients with grade V aneurysms), seven (8.75%) patients had poor neurological status with Glasgow Outcome score of 3), and 30 (37.5%) died during the first 6 months (26.7% of the patients with grade IV and 62% of the patients with grade V aneurysms).The main causes of death were consequences of initial bleeding in patients with Hunt and Hess grade V and vasospasm in patients with Hunt and Hess grade IV . They concluded that early endovascular management of high grade haemorrhage is a feasible option, especially because endovascular manoeuvres can be performed at any time, even during vasospasm.[49]

Lubicz B et al conducted a similar retrospective study in elderly people. Selective embolization using coils was done in 68 patients between the age of 65 and 80 (mean age: 71 years) between 1996 and 2002. Of them, 34 were categorized with I or II Hunt and Hess (HH) grade, 15 with III HH grade, and 19 with IV or V HH grade. The Modified Glasgow Outcome Scale was used to evaluate clinical outcomes. Forty patients,

including the four treated three to six weeks after the initial haemorrhage, had satisfactory or outstanding outcomes (59%). Two patients with an HH grade of I or II were among the 14 patients (20.5%) who had a fair or poor result. Thirteen (93%) of the 14 patients (20.5%) who passed away had a HH grade of IV or V. Of the patients treated, 24 males (35%) and 44 women (65%). They concluded that Selective embolization of ruptured intracranial aneurysms in patients aged 65 years or older is effective and prevents rebleeding. However, the morbidity and mortality rates are higher with high HH grades.[50]

Friedman JA, et al conducted a study in 83 patients with mean age of 56.1 years with aneurysmal subarachnoid haemorrhage who underwent treatment with endovascular GDCs.50 were females and 33 were males. The severity of the SAH was evaluated clinically by using the Hunt-Hess grading at the time of admission. GOS was used to assess the outcome. Sixty-four patients (77%) had a GOS of 4 or 5, nine patients (11%) got a GOS of 2 or 3 and ten patients (12%) passed away. The maximum diameter of the mean aneurysm was 7.8 mm. Of the aneurysms, 65 had a diameter of less than 9 mm, 11 had a diameter of 10–14 mm, 6 had a diameter of 15–24 mm, and 1 had a maximum diameter of 25 mm. They came to the conclusion that using GDCs for endovascular treatment of ruptured cerebral aneurysms has a low morbidity rate and improves overall patient outcomes following subarachnoid haemorrhage .[51]

Raymond J, Roy D. Safety conducted a study on safety the efficacy of endovascular treatment of ruptured intracranial aneurysms. 75 patients with acutely ruptured aneurysms received endovascular therapy. The Hunt and Hess grade was used to categorize patients. There were 18 patients in Grade I (24%), 13 in Grade II (17%), 30 in Grade III (40%), 11 in Grade IV (15%), and 3 in Grade V (4%). Seven percent of the aneurysms were smaller than 15 mm. Of the aneurysms, 44% had wide (> 4 mm) necks and 56% had small (> 4 mm) necks. A six-month clinical follow-up was conducted, and the GOS was used to categorize

the results.At 6 months, the outcomes were as follows: GOS score of 1, 50 patients (6 6 .7 %); GOS score of 2, 4 patients (5 .3 %); GOS score of 3, 4 patients (5 .3 %); and GOS score of 5, 17 patients (2 2 .7 %). The main causes of death and disability at 6 months were the direct effect of the initial haemorrhage (9 %), delayed ischemia (6 .7 %), subsequent bleeding (4 %), intraprocedural rupture (4 %), open surgical complications (3 %), and unrelated deaths (4 %).[52]

Graves VB, Strother CM, Duff TA, Perl J conducted a study in which Guglielmi detachable coils were used to treat 13 patients within 72 hours of the initial aneurysm rupture. According to the Glasgow Outcome Scale, 9 out of 13 patients (69%) had good clinical outcome, 1 out of 13 patients (8%) had poor clinical outcome and 3 out of 13 patients (23%). The 0% subsequent bleed rate seen in this subgroup was significant at a P value of 0.01 assuming that patients receiving conservative (nonsurgical) treatment have a 30% incidence of recurrent bleeding. The results of this study suggested that early Guglielmi detachable coil treatment of ruptured aneurysms may be effective in reducing the incidence of subsequent bleeding and can be done with less complications.[53]

Kuether T et al described experience in “Clinical and angiographic outcomes, for patients receiving Guglielmi detachable coil treatment for cerebral aneurysms”. Seventy-seven aneurysms were treated out of which 31 patients presented with SAH. Sixteen patients (52%) were categorized with either Grade I or Grade II SAH. Five patients (16%) presented with Grade III SAH, and 10 patients (32%) exhibited either Grade IV or Grade V SAH. [54]

MATERIALS AND METHODS

SOURCE OF DATA

Place of study:

The study was conducted at Dayanand Medical College, Ludhiana in Department of Neurosurgery.

Duration of study:

The study was carried out from 1st November 2022- 31st December 2023.

Study design:

Observational study

METHOD OF COLLECTION OF DATA

Inclusion criteria:

- All patients with ruptured posterior circulation aneurysms
- All patients with ruptured anterior circulation intracranial aneurysms without large ICH and mass effect
- All patients consenting for procedure

Exclusion criteria:

- Patients with large intracerebral hematoma
- Patients who opt for surgical clipping
- Low GCS (WFNS Grade 5)

Pre-operative work-up will be carried out for all patients, which includes

- Complete history
- Clinical examination
- Standard laboratory investigations for the fitness of surgery that is Hb, BT, CT, TLC, DLC, FBS, Blood urea, Serum Creatinine, Serum Electrolytes, PTI, SGOT, SGPT, ALP, HBsAg, HCV, HIV.
- CT head scan/ CT Angiography
- Pre-anaesthetic checkup

OPERATIVE TECHNIQUE

Endovascular procedures were performed in the special procedure room (Endovascular lab) by the neurosurgeon under general anaesthesia.

STEPS DURING THE PROCEDURE:

- The skin over the puncture site was cleaned with 10% betadine and parts draped
- Right femoral artery was punctured using seldinger technique
- Needle was removed and guidewire was inserted over which long sheath was inserted
- A catheter was inserted and mounted over the guide wire into the right femoral artery. The catheter was guided up to arch of aorta and major vessels of the brain using fluoroscopy.
- After the catheter had been guided through ,contrast dye was injected and DSA done to identify the aneurysm and surrounding blood vessels
- The aneurysm's dimensions form and other features were noted.
- Working angle was determined
- Next, after removing guidewire, a micro wire was inserted and a micro catheter was inserted into the previous inserted catheter over microwire.
- Microwire was guided up to aneurysm neck and microcatheter was taken up to microwire. Microwire was removed
- Once the micro catheter reached the aneurysm, the coil was inserted and manipulated into the aneurysm by the neurosurgeon
- The coil was separated from the catheter once it was fully inserted into the aneurysm.

- As many coils as were required to fully seal off the aneurysm were placed. The coils forms a mesh-like structure inside the aneurysm.
- After the aneurysm was completely packed with coils, additional X-ray images were taken to confirm that the aneurysm was completely sealed off
- After the confirmation, the catheter was removed and dressing was done at insertion site to stop bleeding
- After the intervention, patient was shifted to ICU for observation.
- A nurse monitored the vital signs, neurological signs, the insertion site and circulation or sensation in the affected leg.
- Dressing from puncture site was removed after 48 hours

.

STATISTICAL ANALYSIS:

Data was described in terms of range, mean +/- SD, median, appropriate frequencies (number of cases) and relative frequencies (percentage) as. For comparing categorical data, Chi square test was performed. Other tests performed were student t test and Fischer test. A probability value (p value) less than 0.05 was considered statistically significant. SPSS version 21.0 was used for data analysis.

OUTCOME:

Outcome was evaluated by using Glasgow Outcome Scale at the time of discharge and two months after discharge.

OBSERVATION AND RESULTS

TABLE 5: AGE DISTRIBUTION OF PATIENTS STUDIED

Age in years	Frequency	Percentage (%)
<= 50 years	15	31.2
>50 years	33	68.8
Total	48	100%

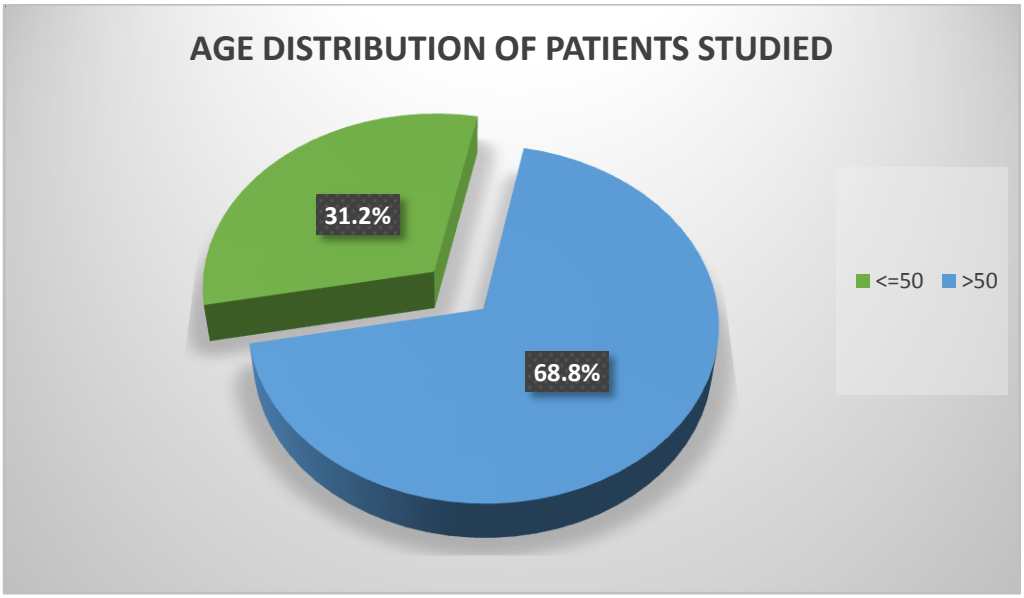

FIGURE 1: AGE DISTRIBUTION OF PATIENTS STUDIED

The mean age of the study group was 54.38 year. 68.8% patients (n=33) were present in age group greater than 50 years. 31.2% patients (n=15) belonged to age group less than equal to 50 years.

TABLE 6: SEX DISTRIBUTION OF PATIENTS STUDIED

SEX	FREQUENCY	PERCENTAGE (%)
MALE	23	47.9%
FEMALE	25	52.1%
Total	48	100%

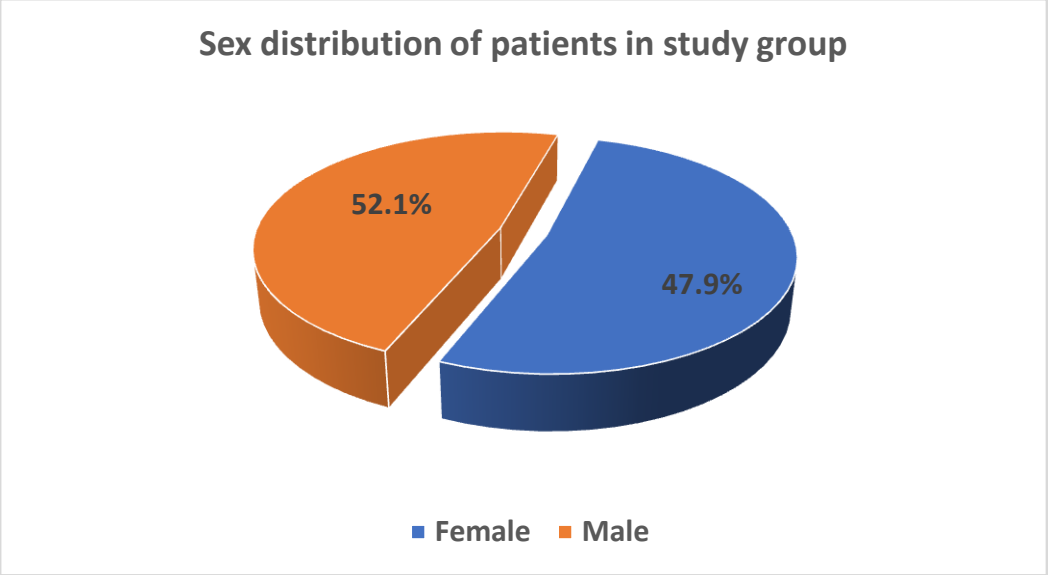

FIGURE 2: SEX DISTRIBUTION OF PATIENTS STUDIED

52.1% PATIENTS (n=25) in our study were in the female group and 47.9% (n=23) were in the male group. Females formed the predominant group in our study.

TABLE 7: SYMPTOMS OF PATIENTS IN RUPTURED INTRACRANIAL ANEURYSMS

SYMPTOMPS	FREQUENCY	PERCENTAGE (%)
Headache	34	70.8
Vomiting	13	27.1
Altered sensorium	21	43.8
Neurological deficit	4	8.3
Seizures	5	10.4
Loss of consciousness	2	4.2
Total	48	100

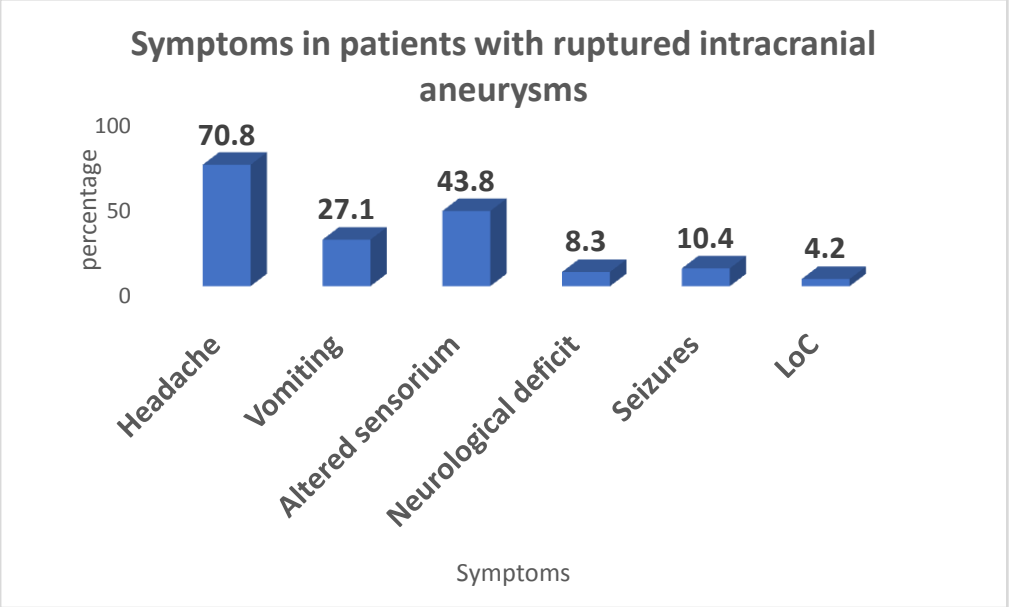

FIGURE 3: SYMPTOMS OF PATIENTS AMONG RUPTURED INTRACRANIAL ANEURYSMS

Most common symptom associated with ruptured intracranial aneurysm was headache in 70.8% patients. It was associated with altered sensorium (43.8%), vomiting (27.1%) and loss of consciousness (4.2%). Neurological deficit like hemiparesis , hemiplegia , cranial nerve palsy was seen in 4 cases(8.3%). Seizures occurred in 5 patients (10.4%).

TABLE 8: TABLE SHOWING NEED FOR PRE OP CSF DIVERSION USING EVD (EXTERNAL VENTRICULAR DRAIN)

Pre op CSF diversion	Frequency	Percentage (%)
EVD required	13	27.1
NO CSF diversion	35	72.9
Total	48	100

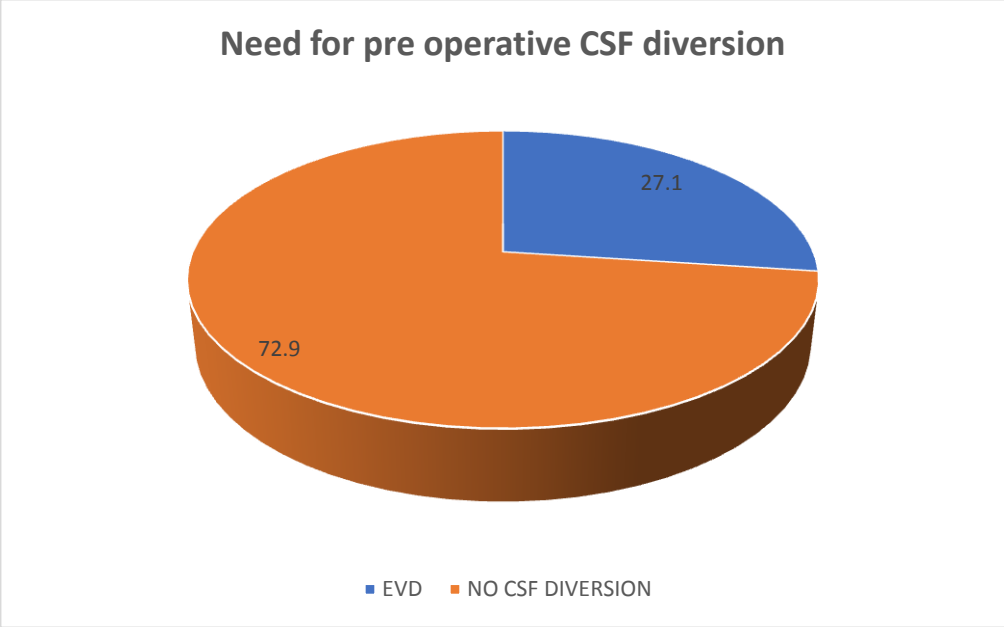

FIGURE 4: FIGURE SHOWING NEED FOR PRE OP CSF DIVERSION IN STUDY GROUP

In our study group only 13 (27.1%) cases required pre operatively external ventricular drain in view of hydrocephalus whereas no pre operative CSF diversion was needed in other 72.9% patients.

TABLE 9: TABLE SHOWING VARIOUS COMORBIDITIES AMONG STUDY GROUP

COMORBIDITY	FREQUENCY	PERCENTAGE(%)
Hypertension	31	64.6
Hypothyroid	5	10.4
Diabetes	3	6.3

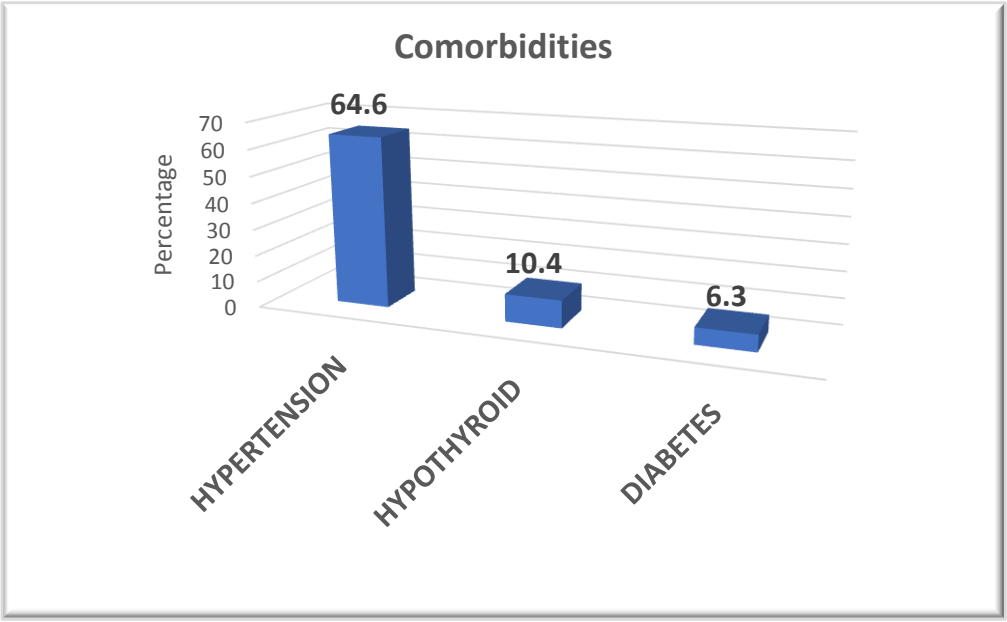

FIGURE 5: GRAPH SHOWING VARIOUS COMORBIDITIES AMONG STUDY GROUP

Hypertension was present among 31 patients (64.6%) with ruptured intracranial aneurysms. Hypothyroidism was present among only 5 patients (10.4%) and diabetes mellitus among 3 patients(6.3%)

TABLE 10: TABLE SHOWING NUMBER OF ANEURYSMS AMONG STUDY GROUP

Number of aneurysms	Frequency	Percentage (%)
ONE	41	85.4
TWO	6	12.5
THREE	1	2.1
Total	48	100

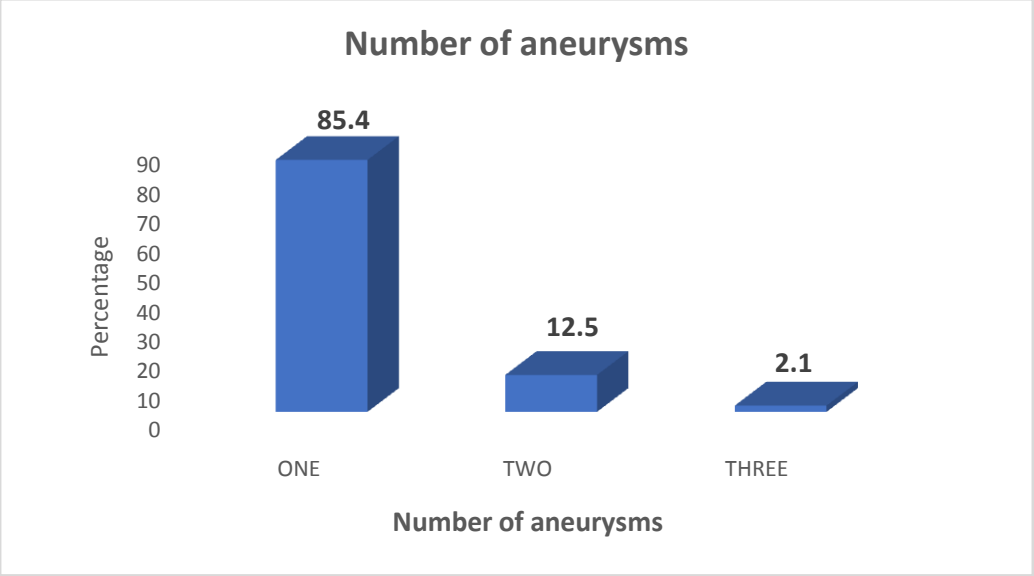

FIGURE 6: PERCENTAGE DISTRIBUTION OF NUMBER OF ANEURYSMS AMONG STUDY GROUP

Above table and graph shows number of aneurysms among study group. 41 patients had single intracranial aneurysm which ruptured. 6 patients had two aneurysms and 1 patient had three aneurysms.

TABLE 11: TABLE SHOWING DISTRIBUTION OF TYPES OF ANEURYSM AMONG STUDY GROUP

ANEURYSM TYPE	FREQUENCY	PERCENTAGE (%)
Saccular	44	91.7
Saccular with Bilobed	4	8.3
Fusiform	0	0
Total	48	100

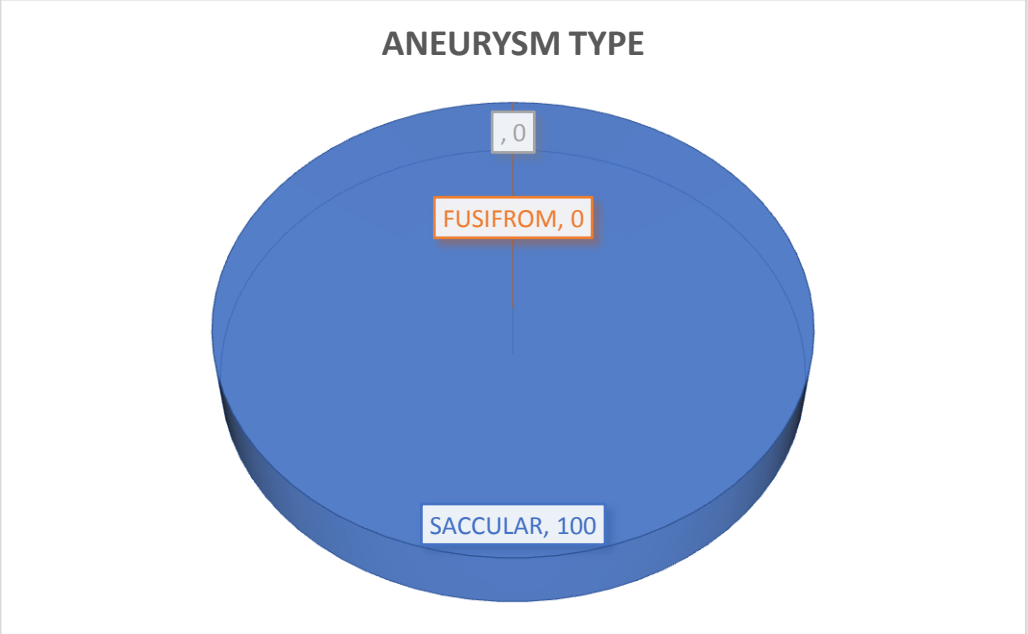

FIGURE 7: DISTRIBUTION OF TYPES OF ANEURYSM AMONG STUDY GROUP

.Our study population had all cases of saccular aneurysms. Out of all 48 cases of saccular aneurysms, 4 were bilobed. None of the aneurysms were fusiform or any pseudoaneurysm

TABLE 12: TABLE SHOWING LOCATION OF RUPTURED INTRACRANIAL ANEURYSMS AMONG STUDY GROUP

LOCATION OF ANEURYSM	FREQUENCY	PERCENTAGE (%)
ACA	9	18.8
Acom	21	43.8
ICA	8	16.7
MCA	4	8.3
PCA	2	4.2
PCom	1	2.1
VA	3	6.3
Total	48	100

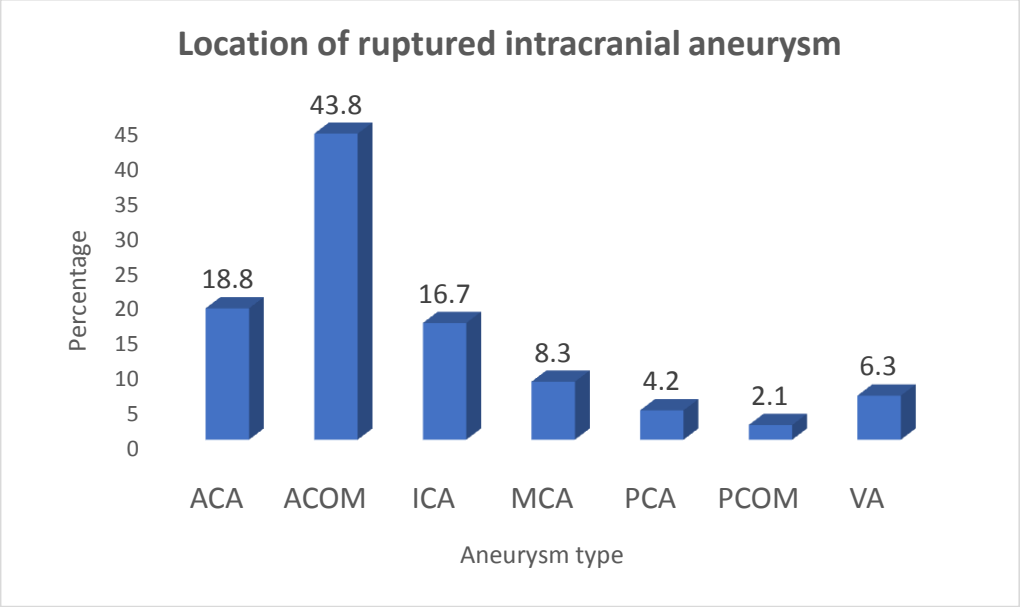

FIGURE 8: LOCATION OF RUPTURED INTRACRANIAL ANEURYSMS AMONG STUDY GROUP

In our study 21 patients (43.8%) had ruptured anterior communicating aneurysm. 9 patients (18.8%) had ruptured anterior cerebral artery aneurysm, 8 patients (16.7%) had ruptured internal carotid artery aneurysm, 4 patients (8.3%) had ruptured middle cerebral artery aneurysm, 3 patients (6.3%) had ruptured vertebral artery aneurysm2 patients (4.2%) had ruptured posterior cerebral artery aneurysm and only 1 patient had ruptured posterior communicating artery aneurysm.

TABLE 13: TABLE SHOWING DISTRIBUTION OF RUPTURED INTRACRANIAL ANEURYSM ACCORDING TO CIRCULATION IN CIRCLE OF WILLIS

TYPE OF CIRCULATION	FREQUENCY	PERCENTAGE (%)
Anterior	43	89.6
Posterior	5	10.4
Total	48	100

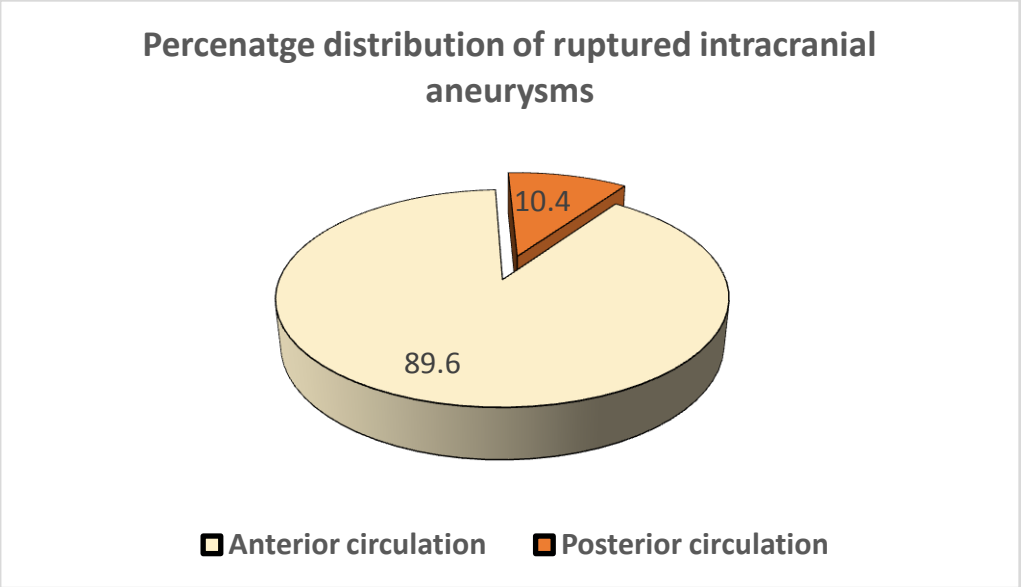

FIGURE 9: DISTRIBUTION OF RUPTURED INTRACRANIAL ANEURYSM ACCORDING TO CIRCULATION IN CIRCLE OF WILLIS

Among our study group 43 patients (89.6%) had ruptured intracranial aneurysm in anterior circulation and in only 5 patients (10.4%) in posterior circulation.

TABLE 14: TABLE SHOWING DISTRIBUTION OF PATIENTS ACCORDING TO HUNT AND HESS GRADING ON ADMISSION

HUNT AND HESS GRADE	NUMBER OF PATIENTS	PERCENTAGE (%)
GRADE 1	12	25
GRADE 2	20	41.7
GRADE 3	12	25
GRADE 4	3	6.3
GRADE 5	1	2.1
Total	48	100

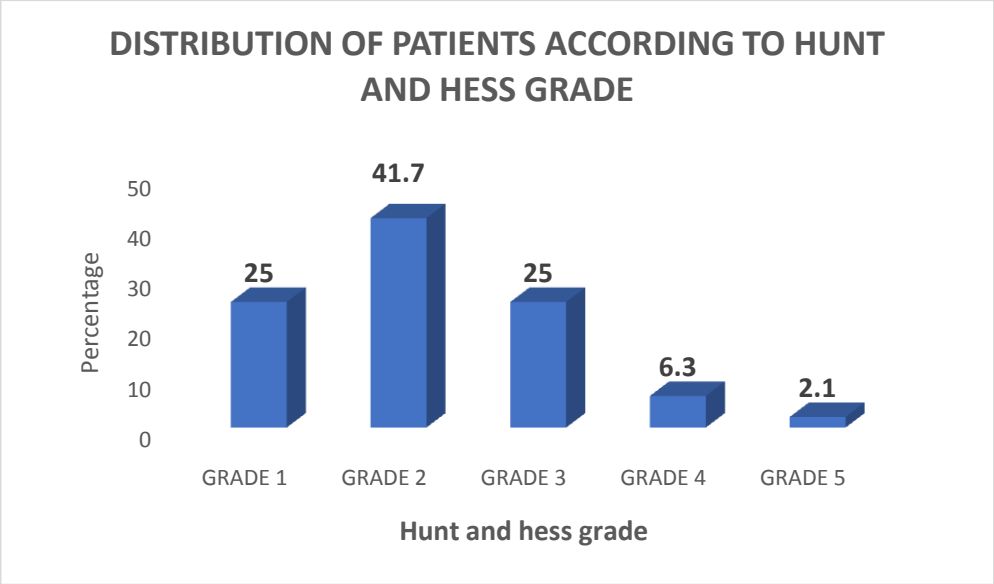

FIGURE 10: DISTRIBUTION OF PATIENTS ACCORDING TO HUNT AND HESS GRADING

12 patients (25%) had grade 1 and grade 3 hunt and hess scale. 20 patients (41.7%) had grade 2 hunt and hess scale. 3 patients (6.3%) had grade 4 and only 1 patient (2.1%) had grade 5 of hunt and hess scale.

TABLE 15: TABLE SHOWING DISTRIBUTION OF PATIENTS ACCORDING TO MODIFIED FISHER SCALE ON ADMISSION

MODIFIED FISHER SCALE	NUMBER OF PATIENTS	PERCENTAGE (%)
Grade 0	1	2.1
Grade 1	12	25
Grade 2	23	47.9
Grade 3	4	8.3
Grade 4	8	16.7
Total	48	100

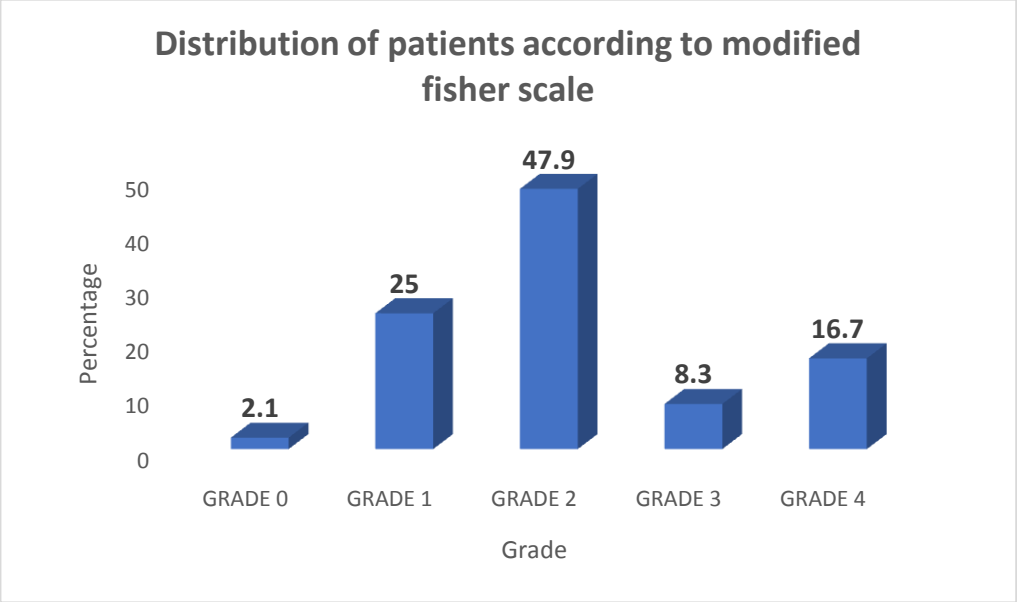

FIGURE 11: GRAPH SHOWING DISTRIBUTION OF PATIENTS ACCORDING TO MODIFIED FISHER SCALE ON ADMISSION

Above table and graph showing distribution of patients according to modified fisher scale on admission. 1 patient had modified fisher scale 0, 12 patients (27.1%) had modified fisher scale 1 , 23 patients (47.9%) had modified fisher scale 2 , 4 patients (8.3%) had modified fisher scale 3 and 8 patients (16.7%) had modified fisher scale 4 among study group.

TABLE 16: TABLE SHOWING DISTRIBUTION OF PATIENTS ACCORDING TO WFNS SCALE

WFNS grade	Frequency	Percentage (%)
GRADE 1	23	47.9
GRADE 2	8	16.7
GRADE 3	4	8.3
GRADE 4	13	27.1
GRADE 5	-	-
Total	48	100

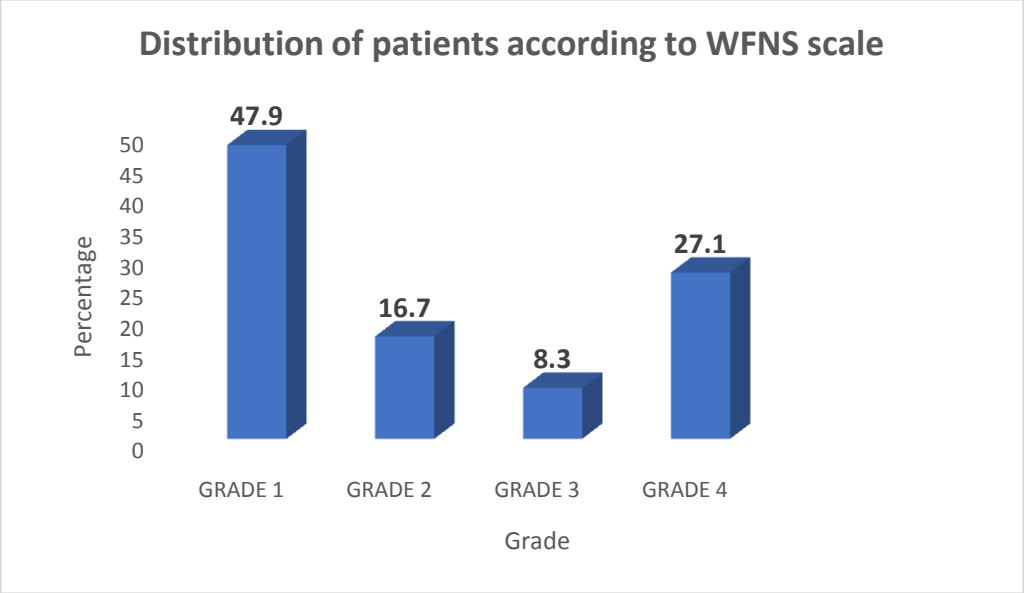

FIGURE 12: GRAPH SHOWING DISTRIBUTION OF PATIENTS ACCORDING TO WFNS SCALE

Above table and graph shows distribution of patients according to World Federation of Neurological Surgeon scale. 23 patients (47.9%) had WFNS scale grade 1 , 8 patients (16.7%) had WFNS scale grade 2 , 4 patients (8.3%) had WFNS scale grade 3 , 13 patients (27.1%) had WFNS scale grade 4. None of the patients with WFNS score of 5 were included in the study group

TABLE 17: TABLE SHOWING DISTRIBUTION OF PATIENTS WITH ENDOVASCULAR COILING

PROCEDURE	FREQUENCY	PERCENTAGE (%)
Endovascular coiling	36	75
Balloon assisted endovascular coiling	7	14.6
Stent assisted endovascular coiling	3	6.3
Endovascular coiling with flow diverter	2	4.2
Total	48	100

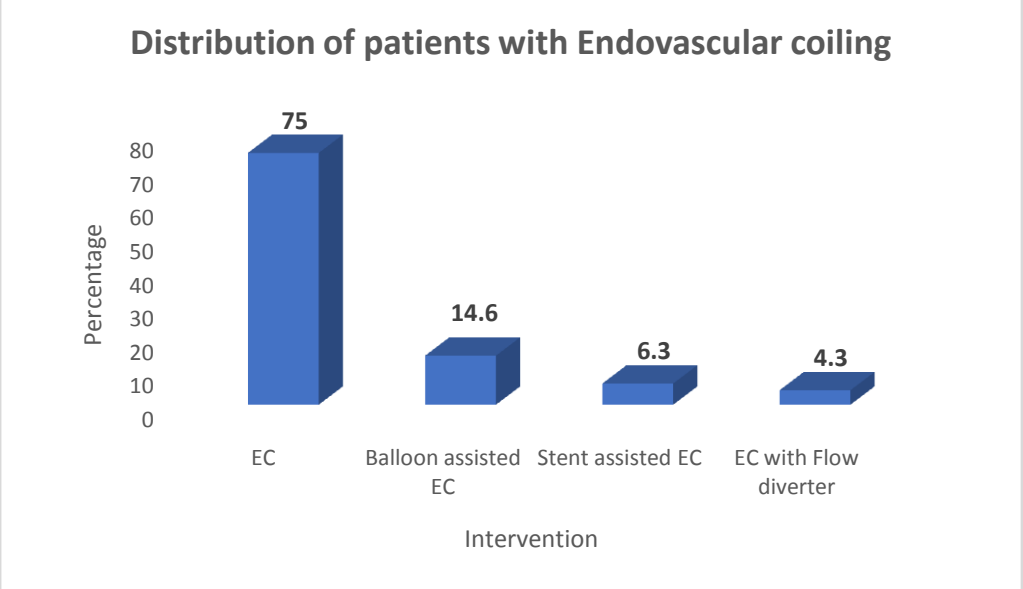

FIGURE 13: GRAPH SHOWING DISTRIBUTION OF PATIENTS WITH ENDOVASCULAR COILING

Above table and graph shows distribution of patients in study group with endovascular coiling (EC). All patients in our study underwent endovascular coiling. 36 patients (75%) underwent endovascular coiling alone . 7 patients (14.6%) underwent endovascular coiling using balloon , 3 patients (6.3%) using endovascular stent and 2 patients (4.2%) underwent endovascular coiling using flow diverter.

TABLE 18: TABLE SHOWING DISTRIBUTION OF PATIENTS ACCORDING TO GCS ON ADMISSION

GCS on admission	Number of patient	Percentage (%)
GCS 3-8	7	14.6
GCS 9-13	9	18.8
GCS 14-15	32	66.7
Total	48	100

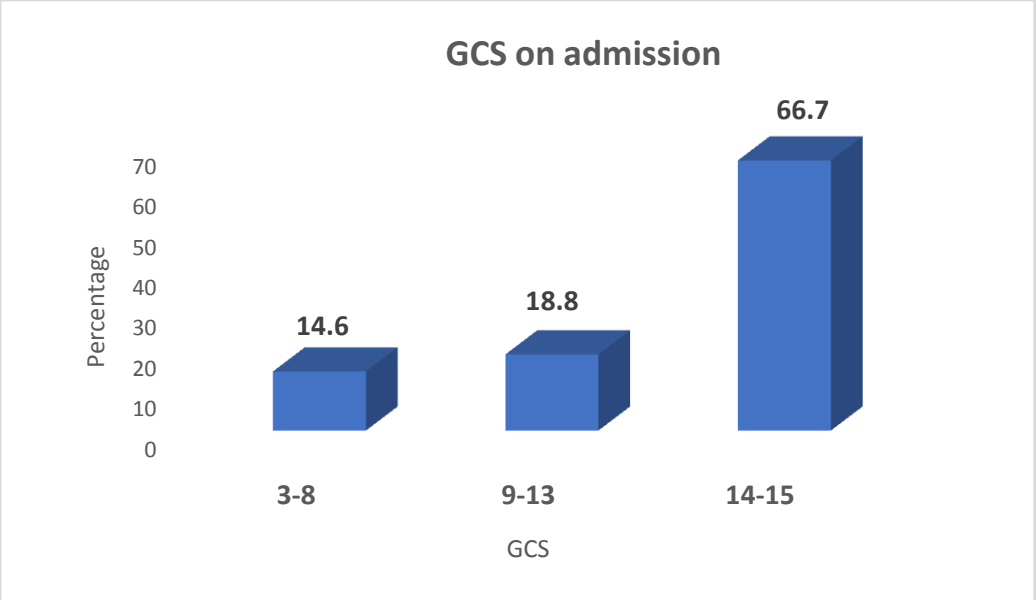

FIGURE 14: GRAPH SHOWING DISTRIBUTION OF PATIENTS ACCORDING TO GCS ON ADMISSION

Above table and graph shows distribution of patients according to GCS on admission. 7 patients had GCS from 3-8, 9 patients had GCS from 9-13 and 32 patients had GCS from 14-15.

TABLE 19: TABLE SHOWING PERCENTAGE DISTRIBUTION OF PATIENTS ACCORDING TO GCS ON ADMISSION, DISCHARGE AND FOLLOW UP

GCS	On admission	On discharge	On follow up at 2 months
GCS 3-8	14.6	2.1	2.1
GCS 9-13	18.8	10.4	10.4
GCS 14-15	66.7	87.5	87.5
Total	100%	100%	100%

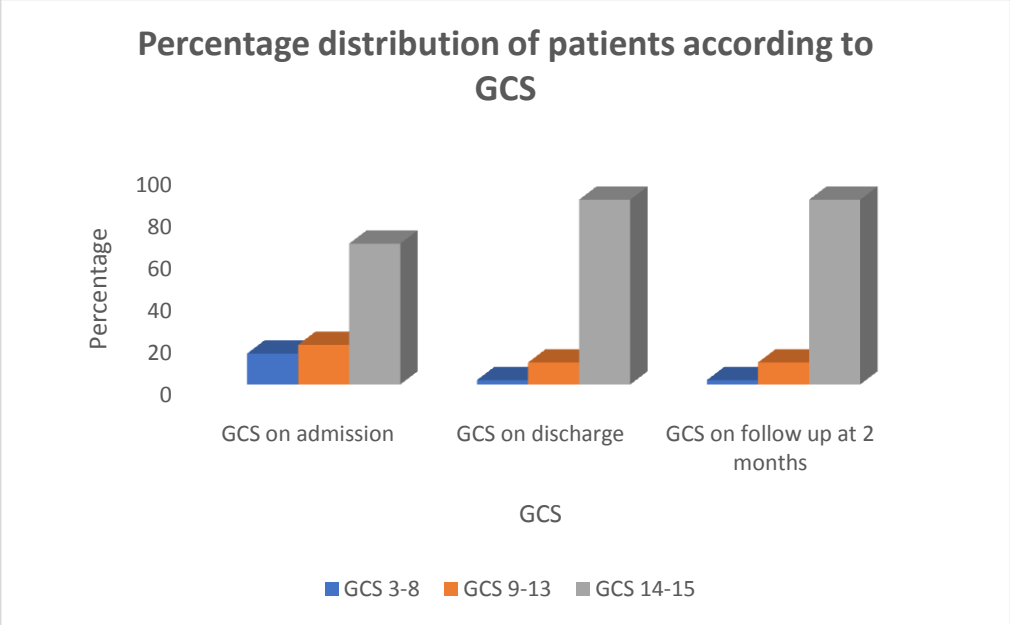

FIGURE 15: GRAPH SHOWING PERCENTAGE DISTRIBUTION OF PATIENTS ACCORDING TO GCS ON ADMISSION, DISCHARGE AND FOLLOW UP

Above table and graph shows percentage distribution of patients according to GCS on admission , discharge and follow up at 2 months. In our study group there were increase in percentage of patients with GCS 14-15 after endovascular coiling at discharge and follow up as compare to GCS on admission. Similarly there was decrease in percentage of patients with GCS 3-8 on admission as compared to at discharge and at follow up after endovascular coiling

TABLE 20: TABLE SHOWING DISTRIBUTION OF PATIENTS ON BASIS OF CLINICAL OUTCOME USING GOS

GLASGOW OUTCOME SCORE	NUMBER OF PATIENTS	PERCENTAGE (%)
1	1	2.1
2	4	8.3
3	9	18.8
4	14	29.2`
5	20	41.7

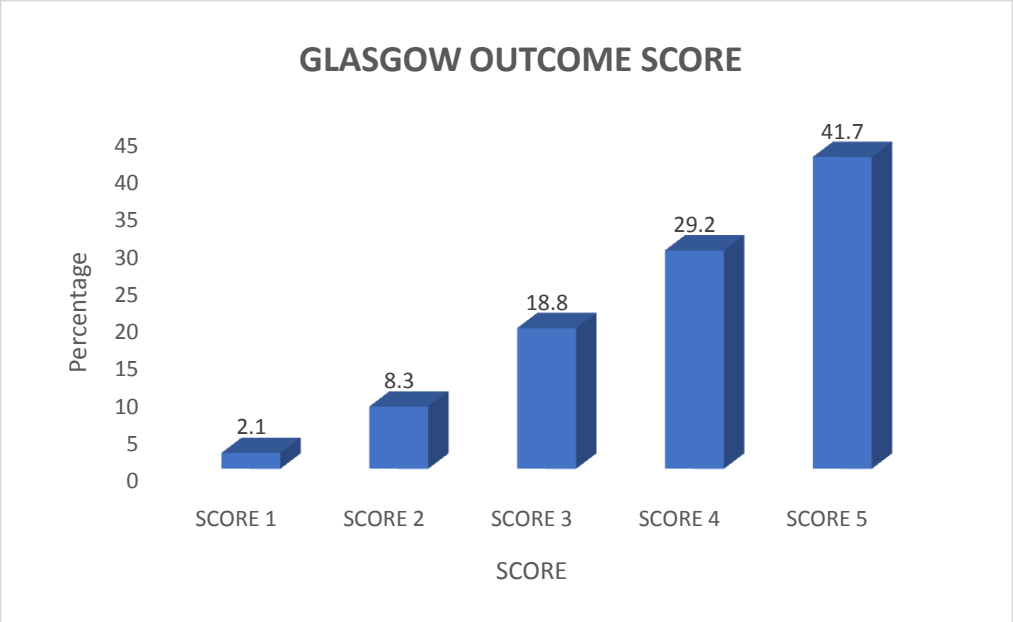

FIGURE 16: GRAPH SHOWING DISTRIBUTION OF PATIENTS ON BASIS OF CLINICAL OUTCOME USING GOS

Above table and graph shows clinical outcome in patients who underwent endovascular coiling using Glasgow outcome score. In our study group 20 patients (41.7%) had GOS 5 with good recovery , 14 patients (29.2%) had GOS 4 with moderate disability , 9 patients (18.8%) had GOS 3 with severe disability, 4 patients (8.3%) had GOS 2 and were in vegetative state and only 1 patient had GOS 1 which expired.

TABLE 21: TABLE SHOWING PATIENTS WITH POST ENDOVASCULAR COILING HYDROCEPHALUS

POST OP HYDROCEPHALUS	NUMBER OF PATIENTS	PERCENTAGE (%)
NO	42	91.7
YES	6	8.3

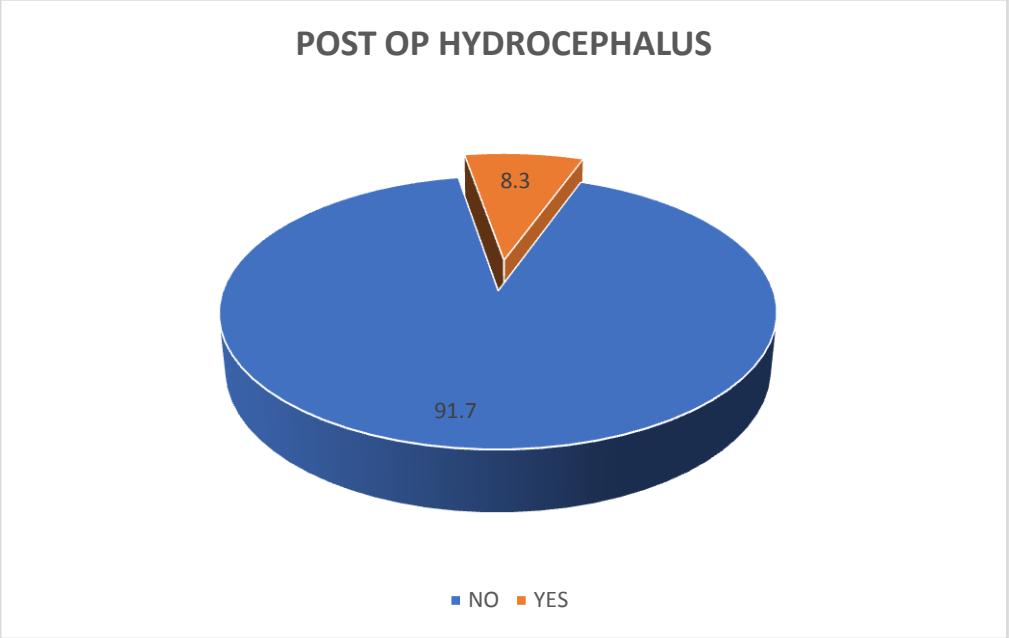

FIGURE 17: GRAPH SHOWING PATIENTS WITH POST ENDOVASCULAR COILING HYDROCEPHALUS

In our study group 6 patients developed post op hydrocephalus.

TABLE 22: TABLE SHOWING PATIENTS WITH POST OP MENINGITIS

POST OP MENINGITIS	NUMBER OF PATIENT	PERCENTAGE (%)
NO	45	93.8
YES	3	6.3
Total	48	100

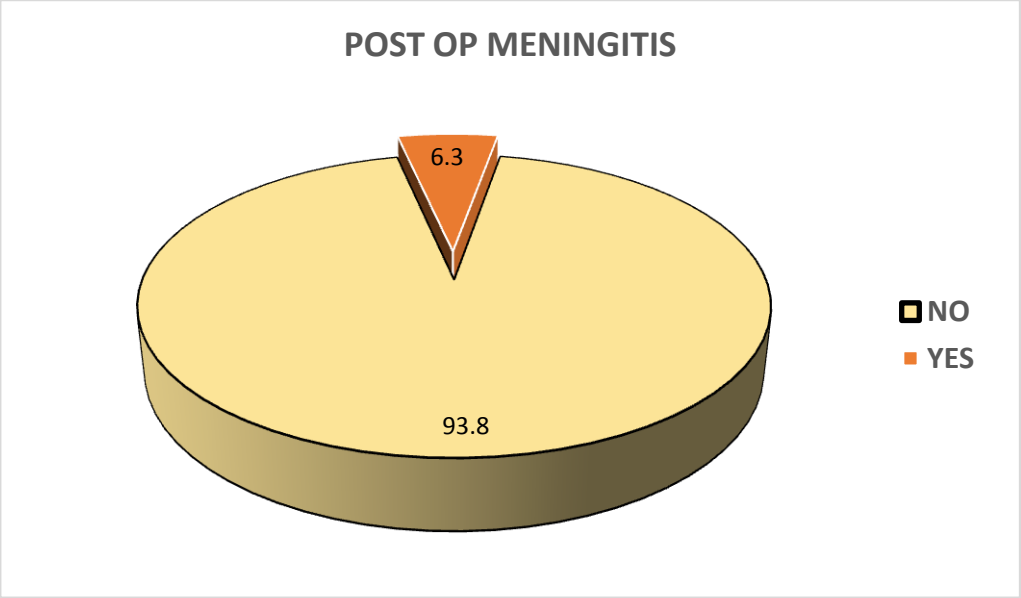

FIGURE 18: GRAPH SHOWING PATIENTS WITH POST OP MENINGITIS

In our study group 3 patients (6.3%) developed meningitis post endovascular coiling

TABLE 23: TABLE SHOWING NEED FOR NEED FOR CSF DIVERSION IN PATIENTS WITH POST OP HYDROCEPHALUS

CSF diversion procedure	Number of patients with post op hydrocephalus	Percentage (%)
EVD	3	50
VP shunt	2	33.3
EVD followed by VP shunt	1	16.7
Total	6	100

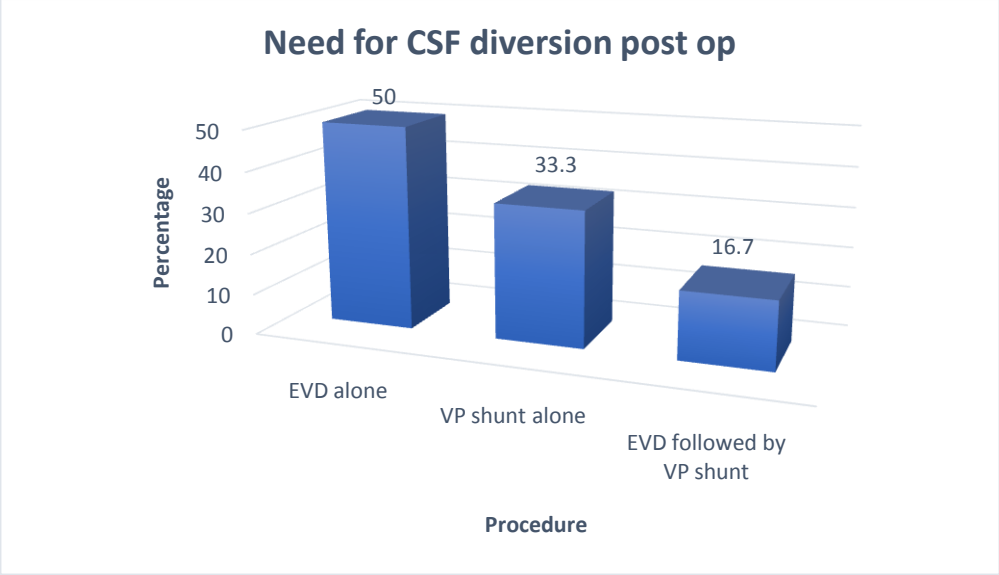

FIGURE 19: GRAPH SHOWING NEED FOR NEED FOR CSF DIVERSION IN PATIENTS WITH POST OP HYDROCEPHALUS

In our study, total 6 patients needed CSF diversion post operatively. 3 patients needed external ventricular drainage alone. 2 patients needed VP shunting. 1 patient underwent EVD first and later VP shunting.

TABLE 24: TABLE SHOWING PATIENTS WITH POST OPERATIVE VASOSPASM

POST OP VASOSPASM	NUMBER OF PATIENTS	PERCENTAGE (%)
NO	29	60.4
YES	19	39.6
Total	48	100

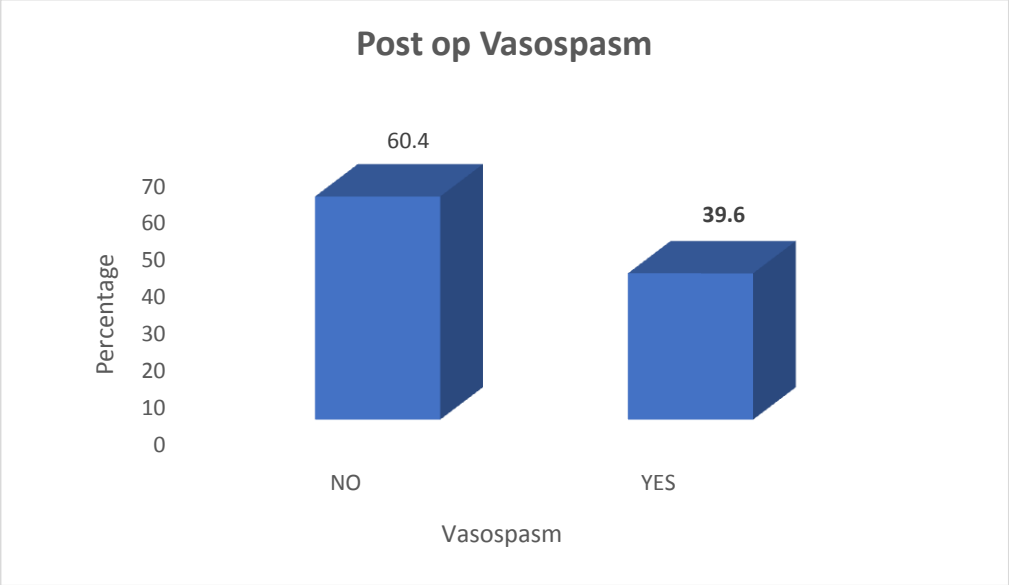

FIGURE 20: GRAPH SHOWING PATIENTS WITH POST OPERATIVE VASOSPASM

In our study 19 patients (39.6%) developed post operative vasospasm.

TABLE 25: TABLE SHOWING POST OPERATIVE INTRAARTERIAL NIMODIPINE INSTILLATION IN PATIENTS

INTRA ARTERIAL NIMODIPINE	FREQUENCY	PERCENTAGE (%)
NO	47	97.9
YES	1	2.1
Total	48	100

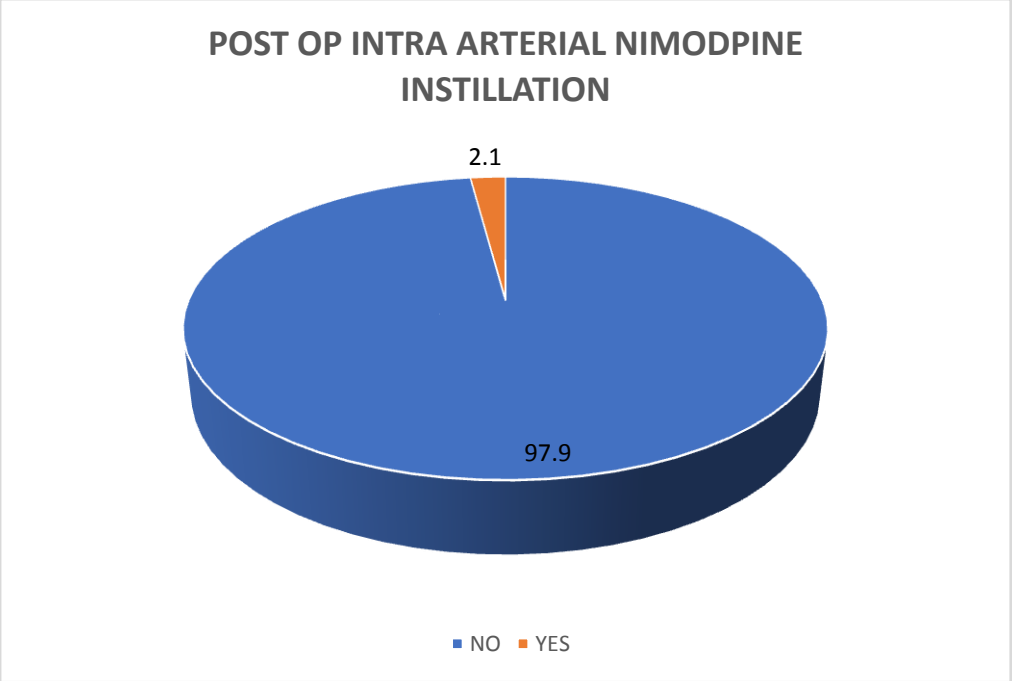

FIGURE 21: GRAPH SHOWING POST OPERATIVE INTRAARTERIAL NIMODIPINE INSTILLATION IN PATIENTS

In our study only one patient (2.1%) needed intraarterial nimodipine instillation post operatively during vasospasm.

TABLE 26: TABLE SHOWING POST OPERATIVE INTRAARTERIAL NIMODIPINE INSTILLATION IN PATIENTS WITH VASOSPASM

PATIENTS WITH POST OP VASOSPASM	FREQUENCY	PERCENTAGE (%)
NOT INSTILLED INTRA ARTERIAL NIMODIPINE	18	94.8
INSTILLED INTRA ARTERIAL NIMODIPINE	1	5.2

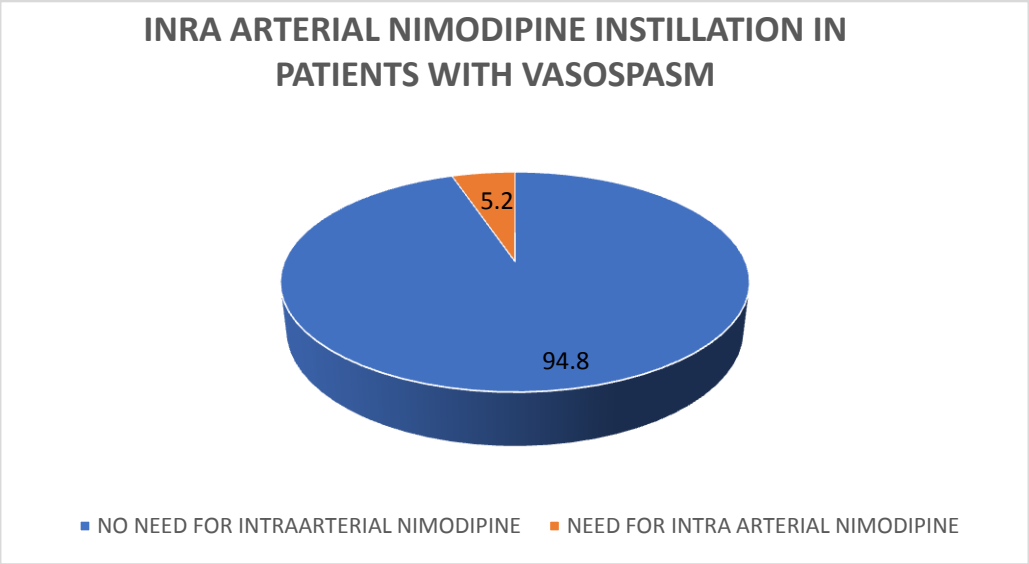
INRA ARTERIAL NIMODIPINE INSTILLATION IN PATIENTS WITH VASOSPASM
5.2
94.8
NO NEED FOR INTRAARTERIAL NIMODIPINE
NEED FOR INTRA ARTERIAL NIMODIPINE

FIGURE 22: GRAPH SHOWING POST OPERATIVE INTRAARTERIAL NIMODIPINE INSTILLATION IN PATIENTS WITH VASOSPASM

TABLE 27: TABLE SHOWING PATIENTS WITH DEVELOPMENT OF INFARCT IN POST OP CT SCAN

POST OP INFARCT IN CT SCAN	FREQUENCY	PERCENTAGE (%)
YES	10	20.8
NO	38	79.2

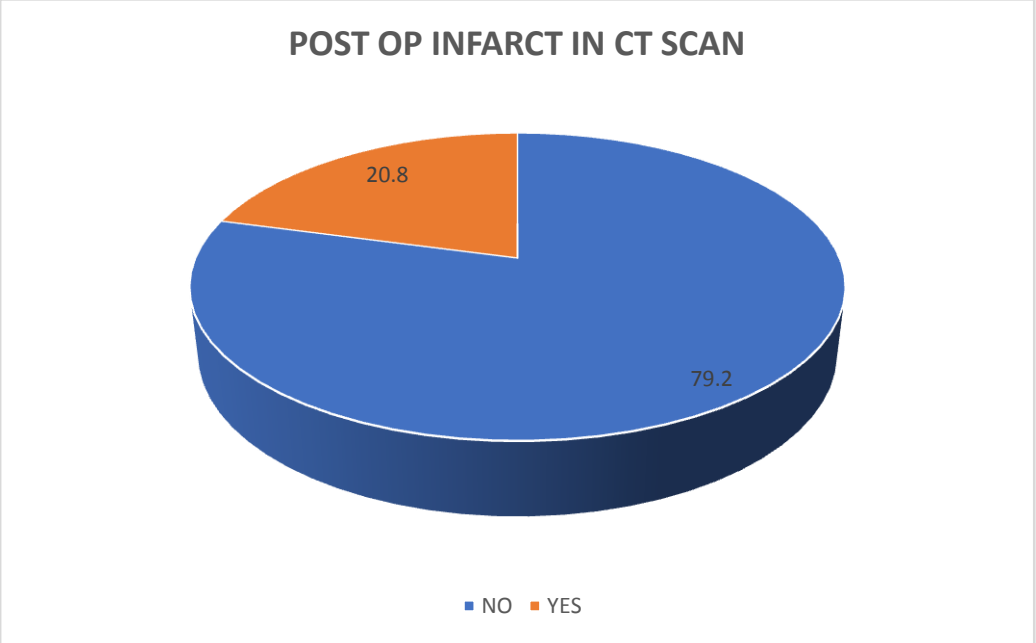

FIGURE 23: GRAPH SHOWING PATIENTS WITH DEVELOPMENT OF INFARCT IN POST OP CT SCAN

Above table and graph shows that 10 (20.8%) patients in our study group developed infarct post endovascular coiling. 2 patients out of 10 underwent decompressive craniectomy

TABLE 28: TABLE SHOWING NEED FOR DECOMPRESSIVE CRANIECTOMY IN PATIENTS WITH INFARCT POST ENDOVASCULAR COILING

DECOMPRESSIVECRANIECTOMY	Frequency	Percentage (%)
YES	2	20
NO	8	80

.

In our study 10 patients developed infarct post operatively. Two patients (20%) needed decompressive craniectomy**.**

TABLE 29: TABLE SHOWING NUMBER OF PATIENTS DISTRIBUTED ACCORDING TO SIZE OF RUPTURED ANEURYSM

SIZE OF ANEURYSM	Frequency	Percentage (%)
Small (<11mm)	46	95.8
Large (11-25mm)	2	4.2
Giant (>25mm)	0	0

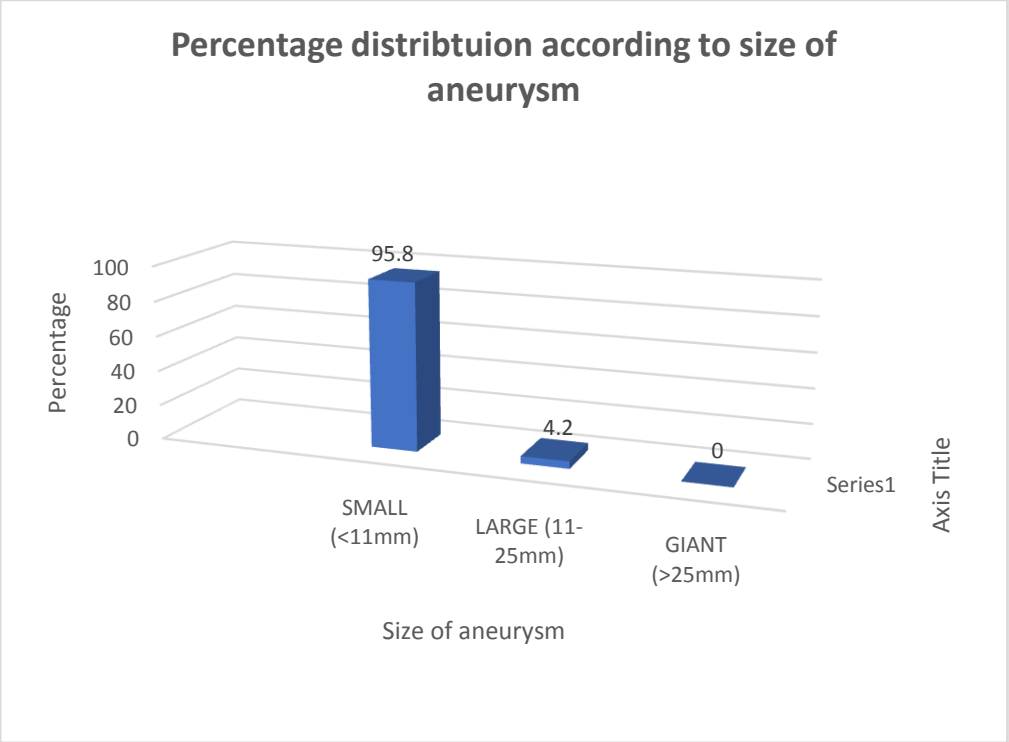

FIGURE 24: GRAPH SHOWING PERCENTAGE DISTRIBUTION OF PATIENTS ACCORDING TO SIZE OF RUPTURED ANEURYSM

TABLE 30: TABLE SHOWING OVERALL CLINICAL OUTCOME ON BASIS OF GLASGOW OUTCOME SCORING IN PATIENTS WITH ENDOVASCULAR COILING

Outcome	Frequency	Percentage (%)
Good (GOS 4,5)	34	70.9
Poor (GOS 1,2,3)	14	29.1

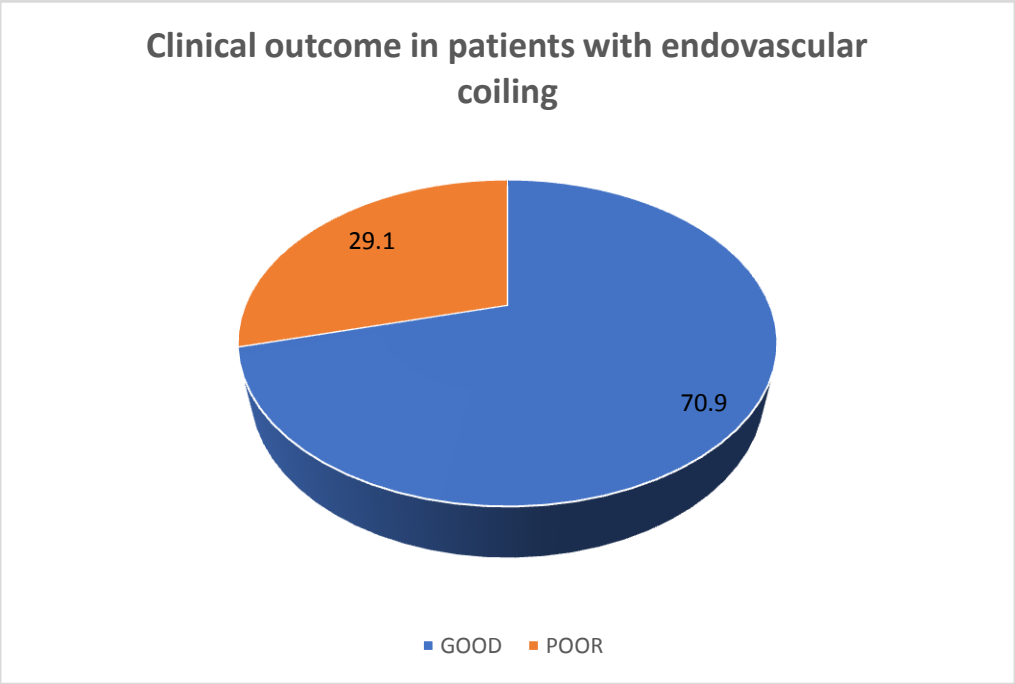

FIGURE 25: GRAPH SHOWING CLINICAL OUTCOME ON BASIS OF GLASGOW OUTCOME SCORING IN PATIENTS WITH ENDOVASCULAR COILING

Above table and figure shows overall clinical outcome on basis of Glasgow Outcome scoring in patients with ruptured intracranial aneurysms who underwent endovascular coiling. 34 patients (70.9%) had good outcome (Glasgow coma score of 4 or 5) whereas only 14 patients (29.1%) had poor outcome (Glasgow coma score of 1 or 2 or 3)

TABLE 31: TABLE SHOWING CLINICAL OUTCOME IN RELATION TO VARIOUS VARIABLES IN OUR STUDY GROUP

Variable	Good Outcome (Mean ± SD)	Poor Outcome (Mean ± SD)	t-value	p-value
Age	53.94 ± 10.67	55.43 ± 11.8	-0.425	0.673
Variable	**Good Outcome**	**Poor Outcome**	**Chi-Square Statistics**	**p-value**
Sex				
Male	14 (41.2%)	9 (64.3%)	2.122	0.145
Female	20 (58.8%)	5 (35.7%)		
Hypertension				
Yes	22 (64.7%)	9 (64.3%)	0.001	0.978
No	12 (35.3%)	5 (35.7%		
Variable	**Good Outcome**	**Poor Outcome**	**Fisher's Exact Test**	**P Value**
Aneurysm Type				
FUSIFORM	0	0	1.000	0.669
SACCULAR	34	14		
Location of Aneurysm				
ACA	7 (20.6%)	2 (14.3%)	10.8	0.04
ACOM	17 (50.0%)	4 (28.6%)		
ICA	6 (17.6%)	2 (14.3%)		
MCA	0 (0.0%)	4 (28.6%)		
PCA	1 (2.9%)	1 (7.1%)		
PCOM	1 (2.9%)	0 (0.0%)		
VA	2 (5.9%)	1 (7.1%)		

Variable	Good Outcome	Poor Outcome	Fisher's Exact Test	P Value
Hunt & Hess Grade				
GRADE 1	10 (29.4%)	2 (14.3%)	3.45	0.578
GRADE 2	14 (41.2%)	6 (42.9%)		
GRADE 3	8 (23.5%)	4 (28.6%)		
GRADE 4	2 (5.9%)	1 (7.1%)		
GRADE 5	0 (0.0%)	1 (7.1%)		
Mod. Fisher Grade				
GRADE 1	12 (35.3%)	1 (7.1%)	4.75	0.16
GRADE 2	15 (44.1%)	8 (57.1%)		
GRADE 3	2 (5.9%)	2 (14.3%)		
GRADE 4	5 (14.7%)	3 (21.4%)		
WFNS				
GRADE 1	18 (52.9%)	5 (35.7%)	4.47	0.32
GRADE 2	5 (14.7%)	3 (21.4%)		
GRADE 3	4 (11.8%)	0 (0.0%)		
GRADE 4	7 (20.6%)	6 (42.9%)		
GRADE 5				

Variable	Good Outcome (Count, %)	Poor Outcome (Count, %)	Chi-Square Test/Fisher Test Statistic	p-value
EC Balloon				
Yes	4 (11.8%)	3 (21.4%)	0.743**	0.32
No	30 (88.2%)	11 (78.6%)		
EC FD				
Yes	2 (5.9%)	0 (0.0%)	0.85**	0.35
No	32 (94.1%)	14 (100.0%)		
EC Stent				
Yes	2 (5.9%)	1 (7.1%)	0.027**	0.9
No	32 (94.1%)	13 (92.9%)		
Meningitis				
Yes	2 (5.9%)	1 (7.1%)	0.027**	0.9
No	32 (94.1%)	13 (92.9%)		
Post-op Vasospasm				
Yes	8 (23.5%)	11 (78.6%)	12.56**	0.001
No	26 (76.5%)	3 (21.4%)		
Post-op intra-arterial nimodipine				
Yes	0 (0.0%)	1 (7.1%)		
No	34 (100.0%)	13 (92.9%)		
Post-op Hydrocephalus				
Yes	3 (8.8%)	3 (21.4%)	1.44**	0.33
No	31 (91.2%)	11 (78.6%)		
Need for VP Shunt post-op				
Yes	1 (2.9%)	3 (21.42%)	4.54**	0.06
No	33 (97.1%)	11 (78.60%)		
Need for EVD post-op				
Yes	2 (5.9%)	2 (14.3%)	0.917**	0.56
No	32 (94.1%)	12 (85.7%)		

Need for Decompression Craniotomy post-coiling				
Yes	0 (0.0%)	2 (14.3%)	5.068*	0.08
No	34 (100.0%)	12 (85.7%)		
Development of infarct in post-op CT scan				
Yes	0 (0.0%)	10 (71.4%)	30.67**	0.000
No	34 (100.0%)	4 (28.6%)		

Fisher Test Value (Where cell count is less than 5)

Measure	**Good Median (IQR)**	**Poor Median (IQR)**	**Mann-Whitney U**	**p-value**
GCS	15.00 (3.75)	12.50 (6.25)	185.500	0.206
Follow up GCS at discharge	15.00 (0.00)	14.50 (5.25)	123.000	0.000
Follow up after 2 months	15.00 (0.00)	14.50 (4.50)	123.000	0.000

DISCUSSION

The present study conducted at Dayanand medical college and hospital ludhiana provides a comprehensive analysis of 48 patients who underwent endovascular coiling for ruptured intracranial aneurysms. The study offers valuable insights into patient demographics, aneurysm characteristics, clinical presentations, treatment modalities and outcome. By comparing our results with other studies; we aim to contextualize our experience within broader landscape of cerebral aneurysm management.

1. Age and sex

Our study had mean age of 54.38 years with slightly higher prevalence in females (52.1%). this demographic profile aligns with global trends that also indicate higher incidence of cerebral aneurysms in middle aged individuals particularly women. Study conducted by Alberto et al had mean age of 57 years with high female prevalence (73%), study by Mohammed elewa had mean age of 45.7+-13 years and slightly high female prevalence (51.6%) , study conducted by Yasser orz et al had mean age of 58 years in males and 61 years in females. In other similar studies conducted by feiyun qin et al mean age was 56.1+-11.2 years and had high female prevalence (51.6%), by Herchel Clarke et al had mean age of 47+-11.6 years with female prevalence of 63.6%

2. Symptoms[55]

Clinically, the most common presentations in our study were headache (70.8%) and altered sensorium (43.8%). The symptoms were consistent with those reported by other studies such as Elewa MK in Egypt where headache was predominant symptom in 65% and altered sensorium was presenting feature in 45%. In another study by Sharma N headache was found to be most common symptom in 76%.These clinical findings underscore the clinical features of aneurysmal SAH and highlight the importance of early symptom recognition. Other symptoms associated with aneurysmal sah were vomiting (27.1%), seizures (10.4%) and loss of consciousness (4.2%). In our study

neurological deficit (hemiparesis/ hemiplegia/ cranial nerve palsy) was present in 8.3%.

3. Risk factors

The most common risk factor associated with aneurysm formation and subsequent rupture was found to be hypertension which was present among 31 cases (64.6%). This finding was found in other similar studies conducted by Feiyun qin et al , J sedat et al, Alberto maud et al where hypertension was found to be an important risk factor in 73% , 52% and 44% respectively. Other associated comorbidities were diabetes mellitus and hypothyroidism. Hypertension was found to be most common known comorbidity in patients with aneurysmal SAH which also corelated with various studies

4. Type of aneurysm

In terms of aneurysm type, our study found that saccular aneurysms were predominant and most common which were present in all 48 cases (100%) in our study group. Of all saccular aneurysms 4 were bilobed. Other types like fusiform and pseudoaneurysm constitute only a smaller fraction indicating predominance of saccular aneurysms as compared with other studies by Decharin et al [56] and Ahmed et al[57]

5. Circulation and location of aneurysm

The aneurysm characterstics in our study showed a majority were located in the anterior circulation (89.6%) among which were located on anterior communicating artery (43.8%) followed by anterior cerebral artery (18.8%) and internal carotid artery(16.7%). These distribution of aneurysms at these locations are consistent with findings of Elewa MK who reported that 40% of aneurysms located in anterior circulation were primarily the Acom and ACA. Decharin et al also noted high prevalence of anterior circulation aneurysms particularly in paraclinoid region. Studies by Alberto maud et al showed majority of intracranial aneurysms were located in anterior circulation (68%), by Feiyun qin et al in anterior circulation (72.1%) of which Acom represented 42%, by J sedat et al in anterior circulation(94.5%) out of which acom represented 52% , by Herchel Clarke et al in anterior circulation (77%) and by Boris lubicz et al in anterior circulation (88%)

6. Glasgow outcome score and hunt and hess grading on admission

Our study distributed the patients according to various grades to assess the severity of aneurysmal sah. Various grades used were hunt and hess clinical grading , modified fisher scoring and WFNS scale. 12 patients (25%) had grade 1 and grade 3 of hunt and hess scale. 20 patients (41.7%) had grade 2 hunt , 3 patients (6.3%) had grade 4 and only 1 patient (2.1%) had grade 5 of hunt and hess scale on admission. Clinical outcome was determined using Glasgow outcome score at discharge and after two months of follow up.in our study group. Clinical outcome was determined as good and poor outcome. Treatment outcomes in our study group were encouraging, with 70.9% of patients achieving good outcome (GOS 4-5) at follow up. This is comparable to the success rates reported by kang et al and Ahmed et al. who found that endovascular coiling resulted in favourable outcomes and lower complications rates as compared to surgical clipping. Similarly Ahmed et al reported a good outcome in 70% cases while kang et al found favourable outcome in 75% of patients treated with endovascular coiling. Among our study group 16 patients had high grade 3-5 of hunt and hess score and 10 patients had good clinical outcome at follow up indicating that early endovascular treatment of high grade haemorrhage is a feasible option as it can be performed at any time even during vasospasm. This is also comparable to study conducted by Serge Bracard et al., Boris lubicz et al , Daisuke Watanabe et al . in another study conducted by Jonathan freidman et al showed 77% had a GOS of 4 or 5 concluding that endovascular treatment of ruptured cerebral aneurysms facilitates good overall outcome in patients after SAH. Our results were also comparable to similar study conducted by Todd A keuther et al in which 81% had good Glasgow outcome score in Grade 1-2 , 100% recovered with grade 3 and 50 % with grade 4-5 indicating that endovascular treatment is safe and efficacious. One patient died in our study because of underlying comorbidity of congestive heart failure.

7. Size of aneurysm and need for remodeling techniques

In our study regarding aneurysm size 95.8% patients had small size aneurysm (<11 mm) , 4.2% were having large aneurysms. None of the patient was having giant aneurysm suggesting increase prevalence of small sized aneurysms which is comparable to studies conducted by Jonathan freidman et al , Alberto maud et al and Daisuke Watanabe et al . In all patients with endovascular coiling 2 were large aneurysms in out of which one needed use of flow diverter. In other patients with small aneurysms 14.6% underwent balloon assisted coiling and 6.3% underwent stent assisted endovascular coiling. Thus study indicates the need for use of various endovascular devices depending upon the size of aneurysm alone.

8. Complications :

A. Vasospasm and brain infarction

Our study noted a higher incidence of post operative vasospasm (39.6%) and infarct development (20.8%). These complications significantly impact long term outcome and highlight the challenges in managing cerebral aneurysm patients. In comparison Elewa MK reported a post operative vasospasm rate of 30% which is slightly lower than our findings but underscores the commonalities of this complication across different settings. The development of infarcts in 20.8% of our patients is also consistent with findings of Ahmed et al who reported a similar incidence of post operative infarcts. Of 20.8% patients with infarcts 2 patients underwent decompressive craniectomy for the same due to severe vasospasm resulting in malignant infarct formation. In one patient intra arterial nimodipine instillation was given to counteract the effect of vasospasm.

B. Hydrocephalus and meningitis

Despite achieving good clinical results following endovascular coiling, need for additional interventions were required in our study. 8.3% of all patients with endovascular coiling developed post op hydrocephalus; which were managed by external ventricular drain alone in 50% and

VP shunt in other 50%. 3 patients with EVD developed meningitis. This highlights the complexity and potential complications associated with this treatment modality.

In our study, patients were distributed according to Glasgow coma scale in three groups. On admission 14.6% patients had GCS 3-8 , 18.8% had GCS 9-13 and 66.7% patients had GCS 14-15. On discharge and at follow up after 2 months only 2.1 % had GCS 3-8 , 10.4% had GCS 9-13 and 87.5% had GCS 14-15. Thusthere were increase in percentage of patients with GCS 14-15 after endovascular coiling at discharge and follow up as compare to GCS on admission. Similarly there was decrease in percentage of patients with GCS 3-8 on admission as compared to at discharge and at follow up after endovascular coiling. Hence our study highlights the importance of surgical intervention of ruptured intracranial aneurysms and shows the efficacy and safety of endovascular coiling in ruptured intracranial aneurysms.

SUMMARY AND CONCLUSION

SUMMARY

Our prospective study on endovascular coiling in patients with ruptured intracranial aneurysms was conducted from 1st December 2022 to 31st December 2023 in department of Neurosurgery, Dayanand Medical College and Hospital, Ludhiana. The summary of our study is as following:

1. Mean age group in whom intracranial aneurysms ruptured was 54.38 years.
2. There was higher incidence of cerebral aneurysms in females (52.1%) as compared to males
3. Most common symptom associated with ruptured intracranial aneurysm was headache (70.8%) followed by altered sensorium (43.8%) and vomiting (27.1%). Seizures occurred in 10.4% of patients, neurological deficit was present in 8.3%
4. 27.1% patients had hydrocephalus after aneurysmal bleed and needed CSF diversion in form of external ventricular drain
5. Most common risk factor associated with patients in our study group was hypertension (64.6%)
6. In our study group all aneurysms were of saccular type among which 4 were bilobed
7. Multiple aneurysms were present in 7 patients out of which 6 patients had two aneurysms and 1 patient had 3 aneurysms
8. Majority of ruptured intracranial aneurysms were in anterior circulation (89.6&) among which most common location of rupture was anterior communicating artery (43.8%) followed by anterior cerebral artery (18.8%), internal carotid artery (16.1%) and middle cerebral artery (8.3%).
9. In patients who underwent endovascular coiling 7 patients (14.6%) underwent balloon assisted coiling, 3 patients (6.3%) needed stent assisted coiling and 2 patients (4.2%) needed flow diverter.
10. Post endovascular coiling number of patients with GCS 14-15 was increased from 66.7% on admission to 87.5% at discharge

11. 6 patients (8.3%) developed post op hydrocephalus for which they underwent CSF diversion i.e. either EVD or VP shunt.
12. Out of 6 patients who developed post op hydrocephalus, in 3 patients EVD was done and in other 3 VP shunting was done.
13. 3 patients who underwent CSF diversion post operatively developed meningitis
14. 19 patients (39.6%) developed post op vasospasm. Among these patients 10 patients (20.8%) developed infarcts. 2 patients underwent decompressive craniectomy. 1 patient with post op vasospasm was given intra arterial nimodipine infusion.
15. 95.8% aneurysms were of small size (<11mm) and only 2 patients had large aneurysm (4.2%)
16. Among 48 patients who underwent endovascular coiling, 34 patients (70.9%) had good clinical outcome (Glasgow coma score 4, 5).

CONCLUSION

Endovascular coiling as a treatment of ruptured intracranial aneurysms has widely been accepted as an alternative to surgical clipping. Selective coil embolization in patients with ruptured intracranial aneurysms is feasible and effective. It prevents rebleeding. Endovascular occlusion of ruptured cerebral aneurysms has low morbidity .However the morbidity and mortality rates are higher with high hunt and hess grade.

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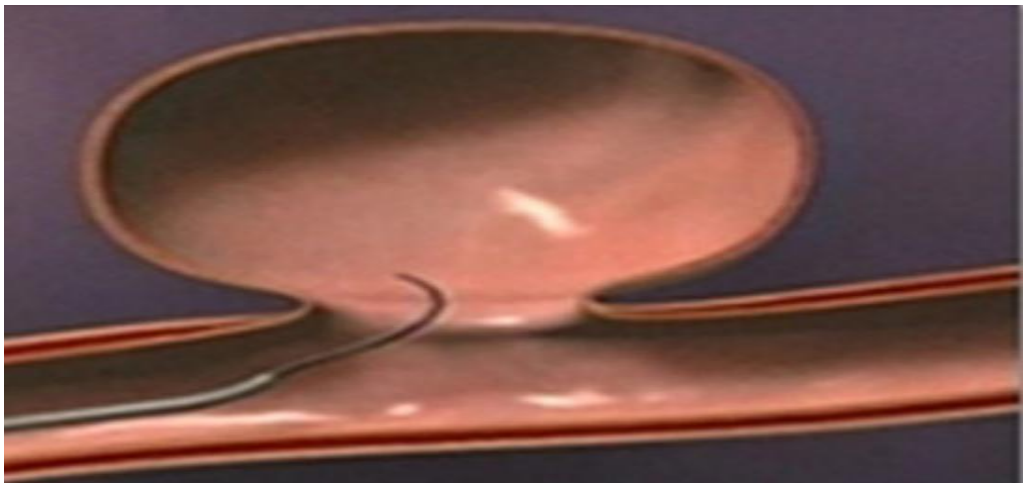
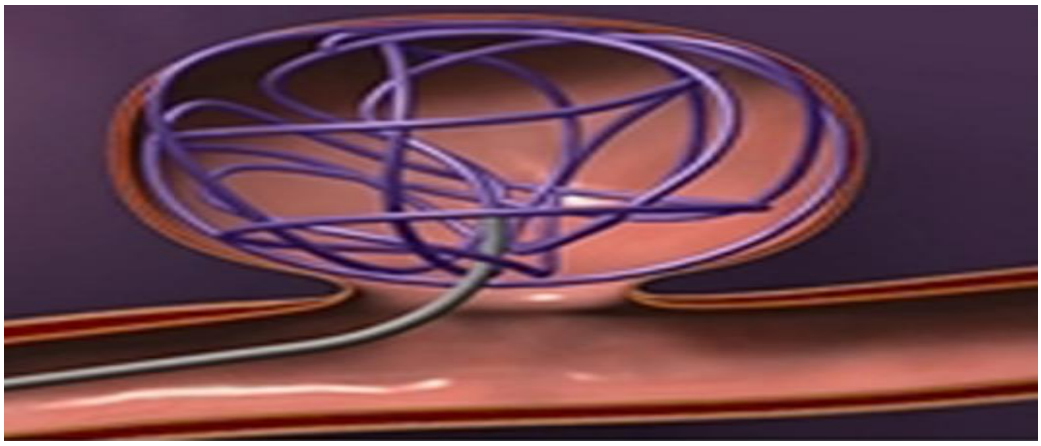
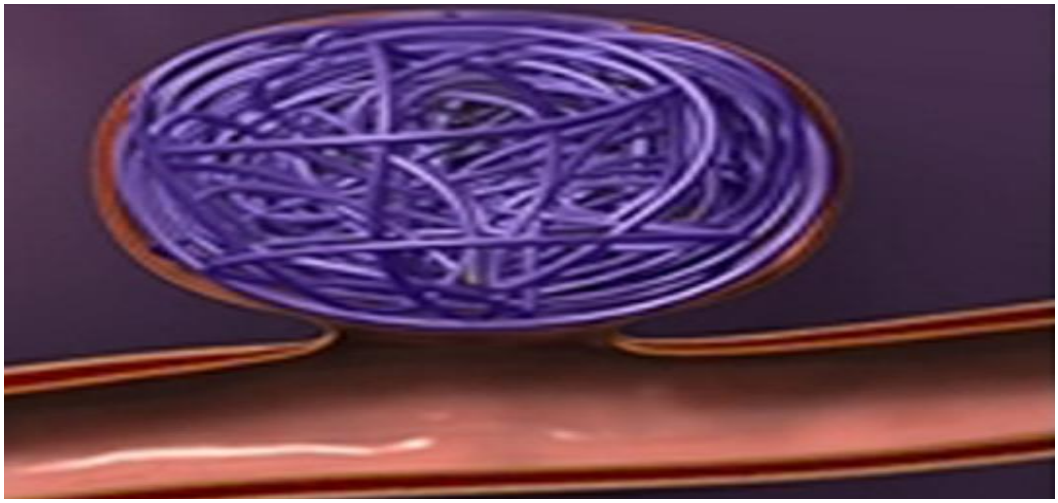


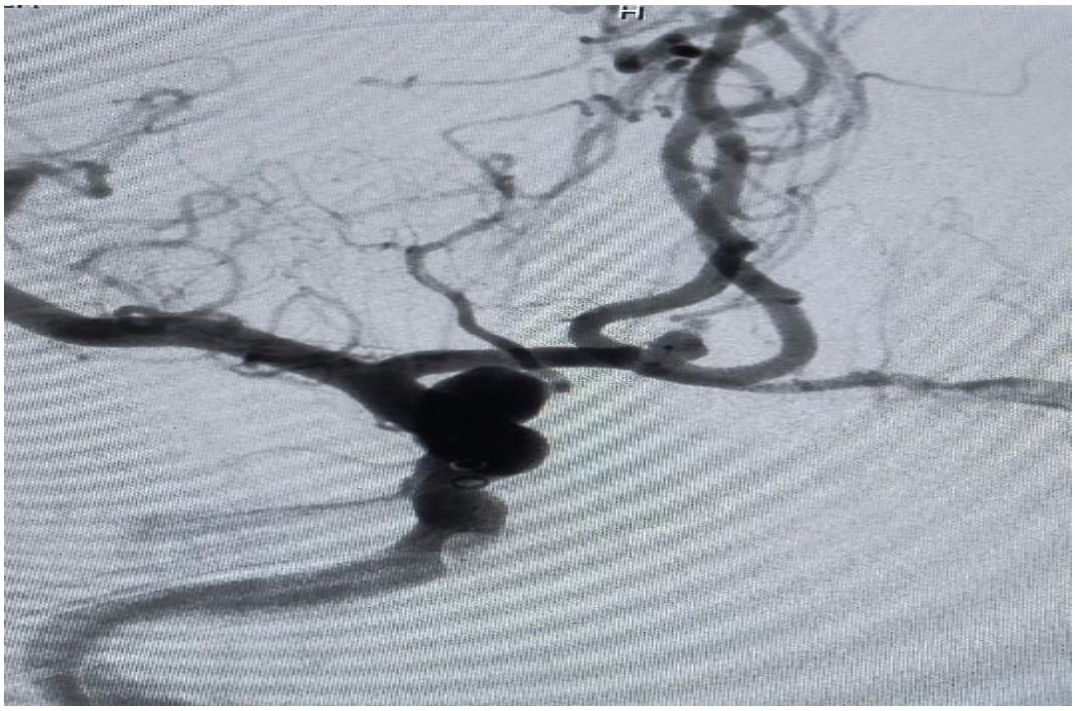
PICTURE 1: MICROCATHETER IS ADVANCED OVER A MICROWIRE



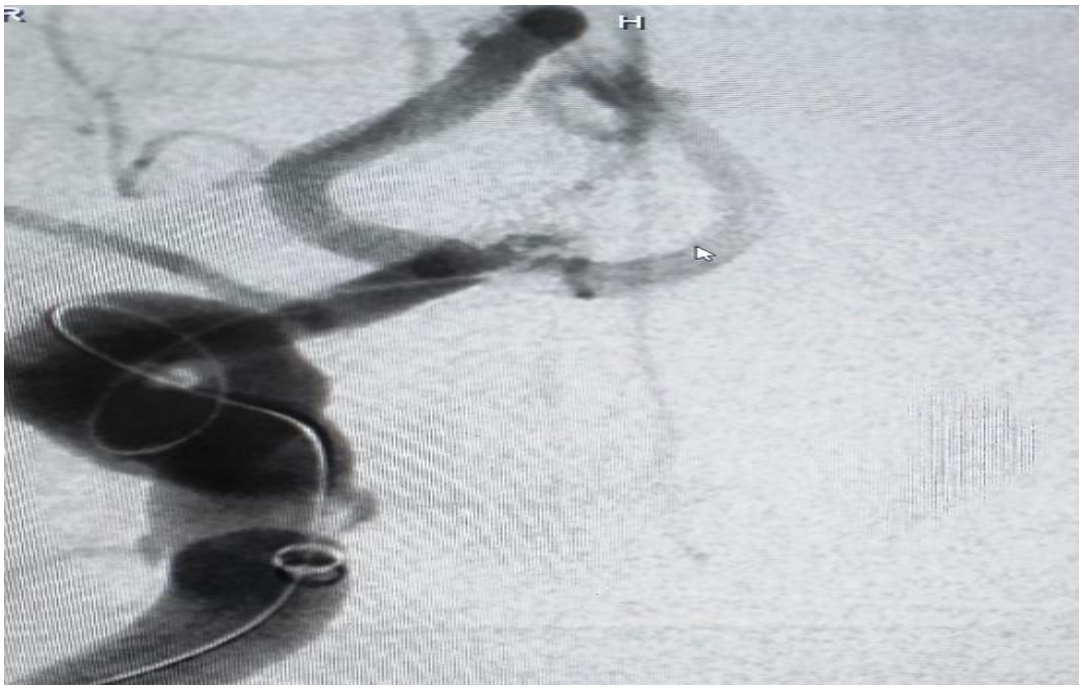
PICTURE 2: THE ANEURYSM IS FILLED WITH COILS, OBSTRUCTING THE FLOW OF BLOOD INTO THE ANEURYSM



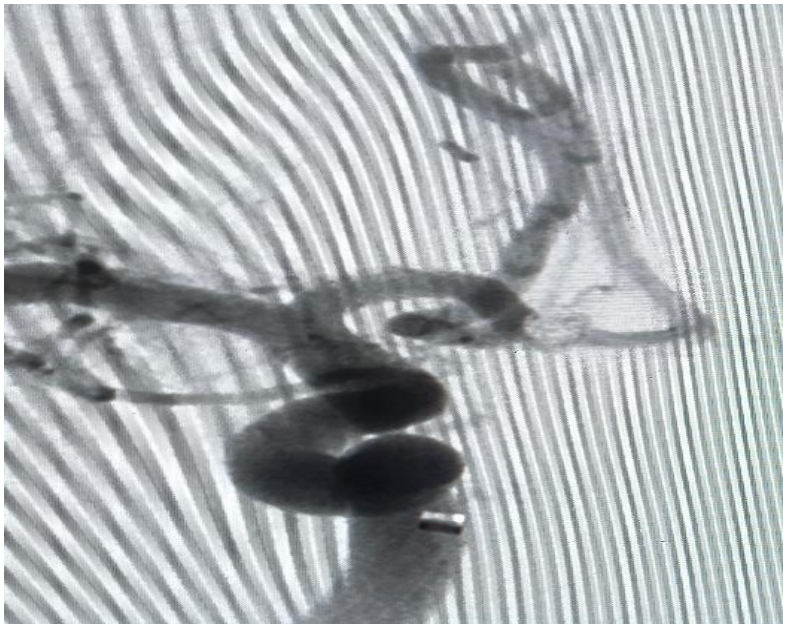
PICTURE 3: TINY COILS ARE DISPENSED THROUGH A MICROCATHETER AND PUSHED INTO THE ANEURYSM



PICTURE 4: PRE OP DSA SHOWING ACOM ANEURYSM

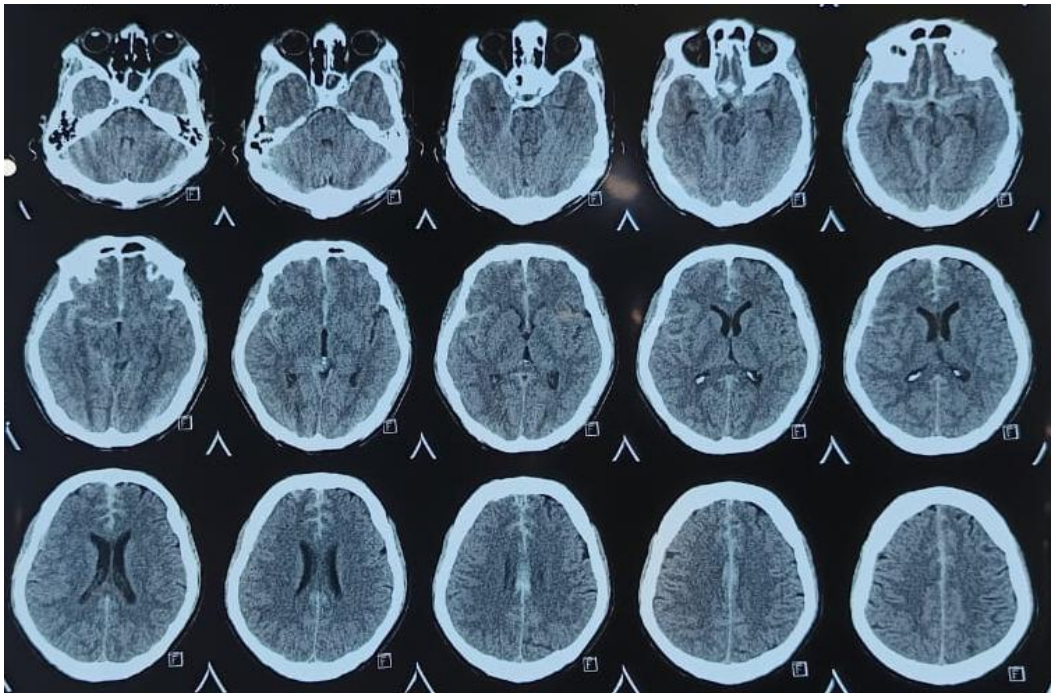


PICTURE 5: ENDOVASCULAR COILS PLACEMENT IN ACOM ANEURYSM.

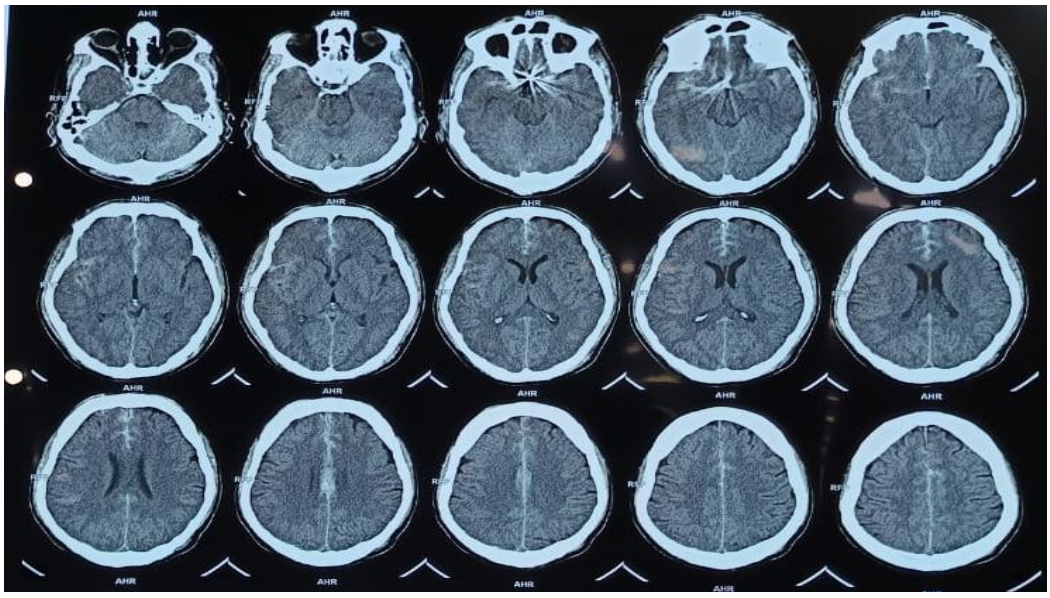


PICTURE 6: DSA AFTER COILING OF ACOM ANEURYSM

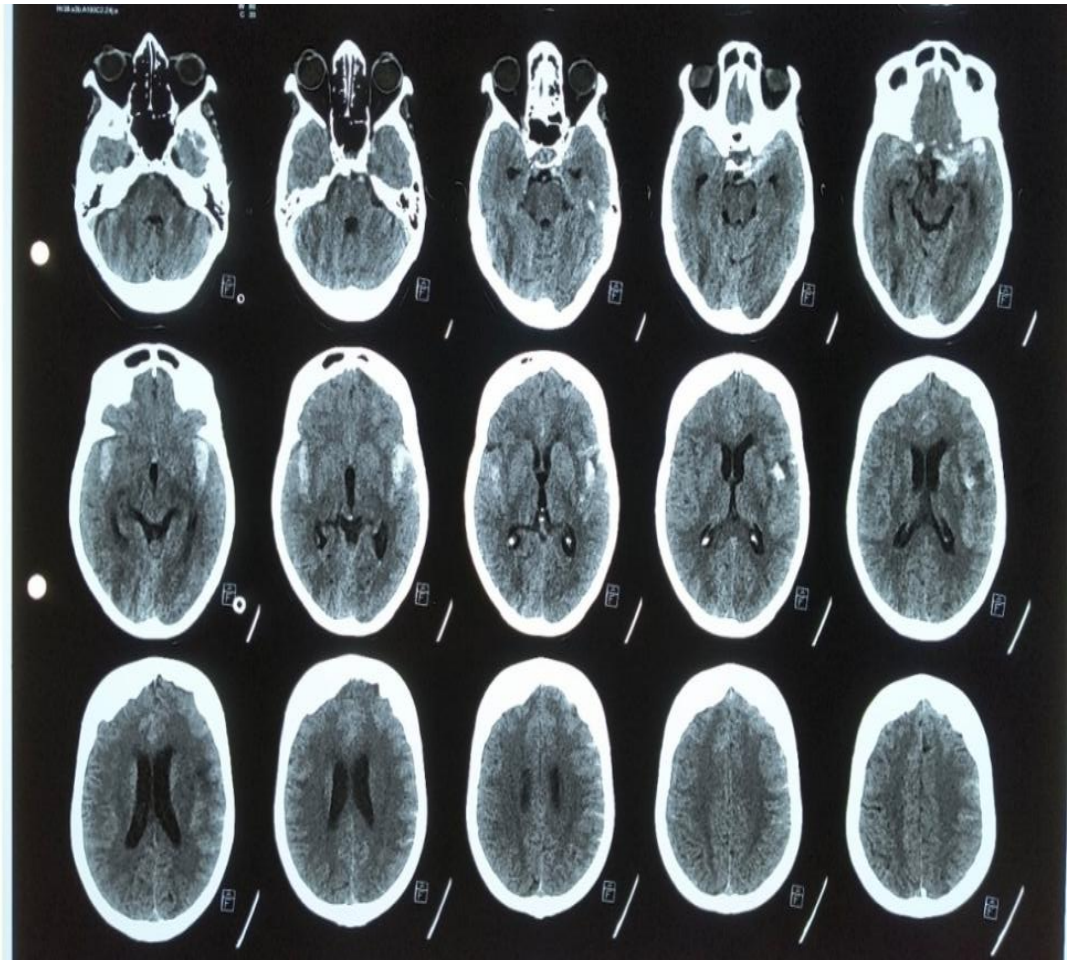
PICTURE 7: ENDOVASCULAR LAB



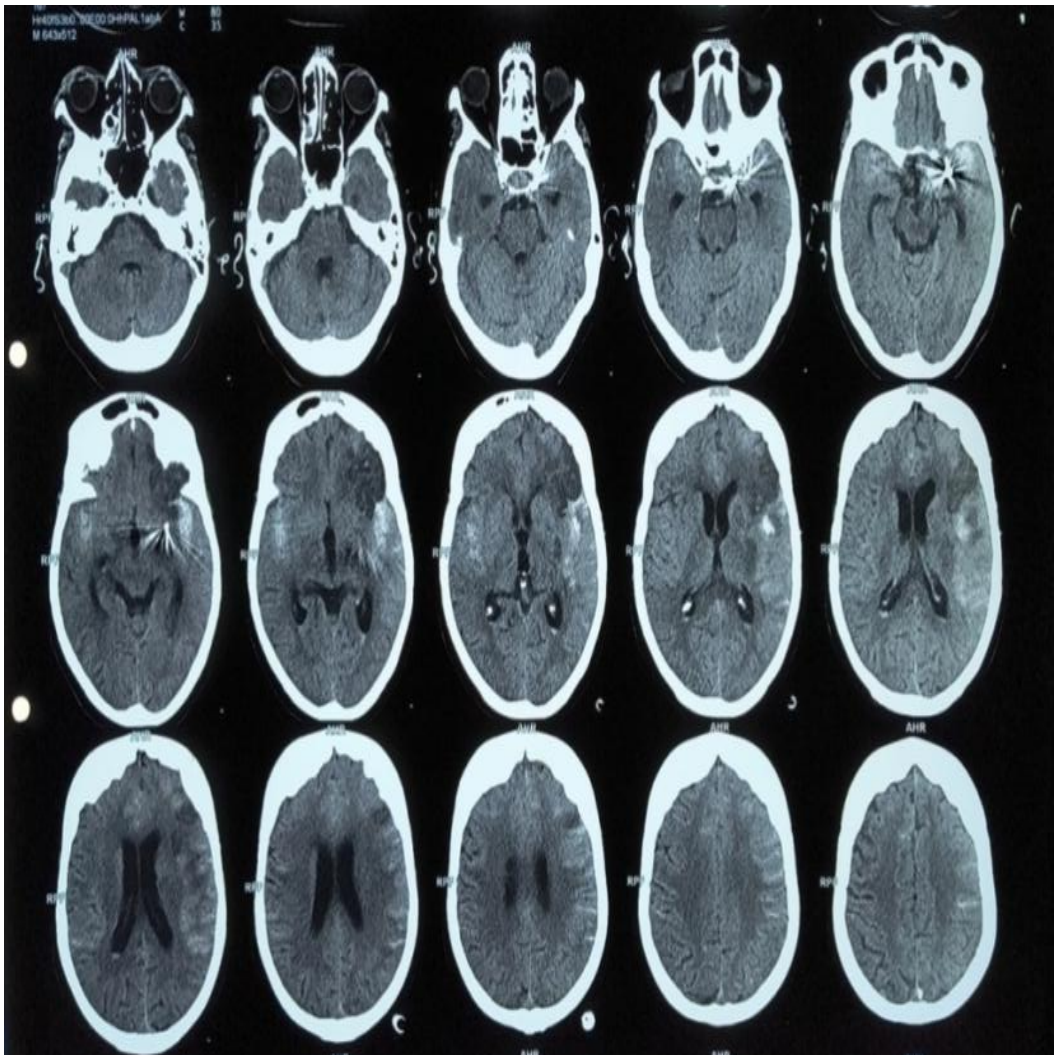
PICTURE 8: PRE OP NCCT HEAD SCAN WITH ANEURYSMAL SAH AT THE SITE OF ACOM ARTERY



PICTURE 9: POST OP SCAN WITH ARTEFACT SUGGESTIVE OF COILS AT SITE OF ACOM ARTERY RUPTURE



PICTURE 10: PRE OP NCCT HEAD SCAN SHOWING ANEURYSMAL SAH AT SITE OF MCA



PICTURE 11: POST OP SCAN SHOWING ARTEFACT AT SITE OF ENDOVASCULAR COILING

S No.	MRD No.	Initials	Age	Sex	Headache	Altered sensorium	Vomiting	LOC	NEUROLOGICAL DEFICIT	Seizures	DIABETES	Hypertension	HYPOTHYROID
1	1307244	SR	52	F	YES	NO	NO	NO	NO	NO	NO	NO	NO
2	1326746	JS	64	M	NO	YES	NO	NO	NO	YES	NO	NO	NO
3	1330280	DS	55	M	NO	YES	NO	NO	NO	NO	NO	YES	NO
4	1329072	SS	48	M	NO	YES	NO	NO	NO	YES	NO	NO	NO
5	1363626	LS	42	M	YES	YES	NO	NO	NO	NO	NO	NO	NO
6	1368424	SD	70	F	YES	YES	NO	NO	NO	NO	YES	YES	NO
7	1373975	JS	25	M	NO	YES	YES	YES	NO	NO	NO	NO	NO
8	1373996	SD	43	F	YES	NO	YES	NO	NO	NO	NO	YES	YES
9	1386470	BS	46	M	YES	YES	NO	NO	NO	NO	NO	YES	NO
10	1388466	SD	68	M	YES	YES	NO	NO	NO	NO	NO	NO	NO
11	1398364	KS	52	M	YES	NO	YES	NO	NO	NO	NO	YES	NO
12	1398350	GS	60	M	YES	NO	NO	NO	NO	NO	NO	YES	NO
13	1403204	RS	65	M	NO	YES	YES	NO	NO	NO	NO	YES	NO
14	1470596	RPS	67	M	NO	YES	NO	NO	NO	YES	NO	NO	NO
15	1416426	RS	53	M	YES	YES	NO	NO	NO	NO	NO	NO	NO
16	1417045	JS	32	M	YES	NO	NO	NO	NO	NO	NO	YES	NO
17	1433843	PK	55	F	YES	NO	YES	NO	NO	NO	NO	YES	YES
18	1445557	PK	57	F	YES	NO	YES	NO	NO	NO	NO	YES	NO
19	1443847	LS	52	M	NO	YES	NO	NO	NO	NO	NO	YES	NO
20	1446767	CD	55	F	YES	NO	NO	NO	NO	NO	NO	YES	YES
21	1443289	RK	51	F	NO	YES	NO	YES	YES	NO	NO	YES	YES
22	1454675	R	50	F	NO	YES	NO	NO	NO	NO	NO	YES	NO
23	1453968	KD	54	F	YES	NO	YES	NO	NO	NO	NO	YES	NO
24	1457386	SS	78	F	YES	NO	YES	NO	NO	NO	NO	YES	NO
25	1468420	AK	45	F	NO	YES	NO	NO	NO	NO	NO	NO	NO
26	1470424	PK	53	M	YES	NO	YES	NO	NO	NO	NO	YES	NO
27	1478517	KD	50	F	NO	YES	NO	NO	NO	NO	NO	NO	NO
28	1491728	GD	52	F	YES	NO	NO	NO	YES	NO	NO	YES	NO
29	707291	VC	47	M	YES	NO	NO	NO	NO	NO	YES	YES	NO
30	1537399	BL	57	F	YES	NO	YES	NO	NO	NO	NO	YES	NO
31	1545574	SS	41	M	NO	YES	NO	NO	NO	NO	NO	YES	NO
32	1546978	VR	74	F	NO	YES	NO	NO	NO	YES	NO	YES	NO
33	1559491	NN	60	M	YES	NO	NO	NO	YES	NO	NO	NO	NO
34	1566924	DK	52	F	YES	NO	NO	NO	NO	YES	NO	NO	NO
35	1577224	KD	58	F	YES	NO	YES	NO	NO	NO	NO	NO	NO
36	1570548	KS	69	M	YES	YES	NO	NO	NO	NO	YES	YES	NO
37	1591240	CK	47	F	YES	NO	NO	NO	NO	NO	NO	YES	NO
38	1593537	JS	63	M	YES	NO	NO	NO	NO	NO	NO	YES	NO
39	1604984	RK	50	F	YES	NO	YES	NO	NO	NO	NO	YES	NO
40	1613481	KK	52	F	YES	NO	YES	NO	NO	NO	NO	YES	NO
41	1628875	RK	54	F	YES	YES	NO	NO	NO	NO	NO	YES	NO
42	1632106	PK	65	F	YES	YES	NO	NO	NO	NO	NO	YES	YES
43	1632721	BS	72	M	YES	NO	NO	NO	NO	NO	NO	NO	NO
44	1639998	GS	30	M	YES	NO	NO	NO	NO	NO	NO	NO	NO
45	1659297	MK	56	F	YES	NO	NO	NO	NO	NO	NO	NO	NO
46	1662439	MK	67	F	YES	NO	NO	NO	NO	NO	NO	YES	NO
47	1659649	GK	56	F	NO	NO	NO	NO	YES	NO	NO	YES	NO
48	1663968	JS	46	M	YES	NO	NO	NO	NO	NO	NO	NO	NO
									NO	NO	NO	NO	NO

S No.	MRD No.	Initials	OTHERS	GPE	Systemic examination	Pre-op CSF Diversion	Pre-op CT scan
1	1307244	SR		WNL	NORMAL	EVD	SAH IN BASAL CISTERNS , SYLVIAN FISSURE, INTER HEMISPHERIC FISSURE WITH HCP
2	1326746	JS		WNL	NORMAL	EVD	ICH IN RT.BASIFRONTAL REGION WITH SAH IN BASAL CISTERNS
3	1330280	DS	HYPERTENSION	WNL	NORMAL	EVD	SAH IN BASAL CISTERNS,SYL.FISS AND IVH WITH HYDROCEPHALUS
4	1329072	SS		WNL	NORMAL	EVD	SAH AND IVH
5	1363626	LS		WNL	NORMAL	EVD	SAH AND IVH
6	1368424	SD	HTN, DM	WNL	NORMAL	EVD	SAH AND IVH
7	1373975	JS		WNL	NORMAL	EVD	DIFFUSE SAH WITH IVH
8	1373996	SD	HTN , HYPOTHYROID	WNL	NORMAL	NO	SAH IN BL SYLVIAN FISSURES ONLY
9	1386470	BS	HTN	WNL	NORMAL	EVD	DIFFUSE SAH WITH IVH
10	1388466	SD		WNL	NORMAL	NO	INTRAPARENCHYMAL BLEED IN RT.FRONTOTEMPORAL REGION.
11	1398364	KS	HTN	WNL	NORMAL	EVD	DIFFUSE SAH WITH IVH
12	1398350	GS	HTN	WNL	NORMAL	EVD	DIFFUSE SAH WITH IVH
13	1403204	RS	HTN	WNL	NORMAL	EVD	SAH WITH IVH WITH RT.FRONTAL HMRGIC CONTUSIONS
14	1470596	RPS		WNL	NORMAL	EVD	DIFFUSE SULCAL SAH AND IVH
15	1416426	RS		WNL	NORMAL	NO	DIFFUSE SAH WITH MIN.IVH
16	1417045	JS	HTN	WNL	NORMAL	NO	SAH IN RT. SYLVIAN FISSURE
17	1433843	PK	HTN , HYPOTHYROID	WNL	NORMAL	NO	RT.THALAMIC BLEED WITH IVH
18	1445557	PK	HTN	WNL	NORMAL	NO	IVH IN B/L OCCIPITAL HORNS
19	1443847	LS	HTN	WNL	NORMAL	NO	SAH IN B/L SYLVIAN FISSURE, RT.CEREBRAL CONVEXITY WITH IVH
20	1446767	CD	HTN, HYPOTHYROIDISM	WNL	NORMAL	NO	SAH IN B/L SYLVIAN FISSUREWITH IVH IN B/L VENTRICLES AND THIRD VENTRICLE
21	1443289	RK	HTN, HYPOTHYROIDISM	WNL	NORMAL	NO	SAH IN LEFT SYLVIAN FISSURE
22	1454675	R	HTN	WNL	NORMAL	NO	EXTENSIVE SULCAL SAH WITH IVH
23	1453968	KD	HTN	WNL	NORMAL	NO	SUPRATENETORIAL SAH WITH INTRAPARENCHYMAL BLEED
24	1457386	SS	YES	WNL	NORMAL	NO	RIGHT SIDE PONTINE BLEED
25	1468420	AK		WNL	NORMAL	NO	SAH IN B/LSULCI HIGH FRONTO PARIETAL LOBE AND SYLVIAN FISSURE WITH IVH
26	1470424	PK	HTN	WNL	NORMAL	NO	SAH IN B/L MCA CISTERNS, LEFT SYLVIAN FISSURE AND INTERPENDUNCULAR CISTERN
27	1478517	KD	YES	WNL	NORMAL	NO	SAH IN INTERPENDUNCULAR, RT.AMBIENT AND RT.CP ANGLE CISTERN WITH IVH
28	1491728	GD	HTN	WNL	NORMAL	NO	NO SAH AND IVH
29	707291	VC	YES	WNL	NORMAL	NO	RIGHT PARIETO-OCCIPTAL INFARCT WITH IVH
30	1537399	BL	HTN	WNL	NORMAL	NO	HYPERDENSE LESION WITH CALCIFICATION IN SUPRASELLAR REGION WITH MINIMAL SAH
31	1545574	SS	HTN	WNL	NORMAL	NO	DIFFUSE SAH WITH IVH IN B/L LATERAL VENTRICLES
32	1546978	VR	YES	WNL	NORMAL	NO	DIFFUSE SAH WITH IVH IN B/L LATERAL VENTRICLES
33	1559491	NN		WNL	NORMAL	NO	DIFFUSE SAH WITH IVH
34	1566924	DK		WNL	NORMAL	NO	SAH IN RT.SYLVIAN FISSURE, MCA CISTERN AND CISTERNA AMBIENS
35	1577224	KD		WNL	NORMAL	NO	INTRAPARENCHYMAL BLEED IN LT.FRONTAL REGION.
36	1570548	KS	HTN, DM	WNL	NORMAL	NO	SAH IN SUPRA SELLAR CISTERN AND B/L SYLVIAN FISSURE WITH IVH
37	1591240	CK	HTN	WNL	NORMAL	NO	SAH IN INTERHEMISPHERIC FISSURE
38	1593537	JS	HTN	WNL	NORMAL	NO	SAH WITH IVH IN RT.SYLVIAN FISSURE AND OCCIPITAL HORNS
39	1604984	RK	HTN	WNL	NORMAL	NO	SAH
40	1613481	KK	HTN	WNL	NORMAL	NO	NAD
41	1628875	RK	HTN	WNL	NORMAL	NO	SAH IN BILATERAL SYLVIAN FISSURE
42	1632106	PK	HTN , HYPOTHYROID	WNL	NORMAL	NO	INTERAPARENCHYMAL BLEED IN LEFT BASIFRONTAL REGION WITH SAH
43	1632721	BS		WNL	NORMAL	NO	SPONTANEOUS SAH IN BL SYLVIAN FISSURE AND INTERHEMISPHERI FISSURE
44	1639998	GS		WNL	NORMAL	NO	INTRAPARENCHYMAL BLEED LEFT FRONTAL REGION
45	1659297	MK	DEPRESSIVE ILLNESS	WNL	NORMAL	NO	SAH IN B/L SYLVIAN FISSURE , SUPRASELLAR , AMBIENT CISTERNS
46	1662439	MK	HTN	WNL	NORMAL	NO	SAH IN LEFT SYLVIAN FISSURE AND LEFT FRONTAL REGION
47	1659649	GK	HTN	WNL	NORMAL	EVD	EXTENSIVE SAH IN INTERPEDUNCULAR CISTERN , BASAL CISTERNS WITH IVH WITH ODEMA
48	1663968	JS		WNL	NORMAL	NO	EXTENSIVE SULCAL SAH WITH IVH

S No.	MRD No.	Initials	Pre-op CT Angiography	Aneurysm Size	size classification	Aneurysm Type
1	1307244	SR	LEFT MCA BIFURCATION	5.9*3.8*1.9	SMALL	SACCULAR
2	1326746	JS	RUPTURED ACOM	6.7*2.8*2.1	SMALL	SACCULAR
3	1330280	DS	ACOM ANEURYSM	2.8*1.9*2.6MM	SMALL	SACCULAR
4	1329072	SS	ACOM ANEURYSM	5.9*3.1*3.9	SMALL	SACCULAR
5	1363626	LS	ACOM ANEURYSM	4.8*3.5*1.8	SMALL	SSCCULAR
6	1368424	SD	ACOM ANEURYSM	6.9*4.9*2.2	SMALL	SACCULAR
7	1373975	JS	ACOM ANEURYSM	6.7*28*2.1	LARGE	SACCULAR
8	1373996	SD	RT.ACA A3	5.5*4.4*1.1	SMALL	SACCULAR
9	1386470	BS	ACOM ANEURYSM	7.8*4.7*4.3	SMALL	SACCULAR BILOBED
10	1388466	SD	ACOM ANEURYSM	6.7*8.2*3.2	SMALL	SACCULAR BILOBED
11	1398364	KS	ACOM ANEURYSM	1.7*1.5*1.9	SMALL	SACCULAR
12	1398350	GS	ACOM ANEURYSM	2.8*1.9*2.6MM	SMALL	SACCULAR
13	1403204	RS	ACOM ANEURYSM	4.4*2.2*2.6	SMALL	SACCULAR
14	1470596	RPS	DACA ANEURYSM	5*4.4*2.5	SMALL	SACCULAR
15	1416426	RS	ACOM ANEURYSM	1.8*1.1*1.2	SMALL	SACCULAR
16	1417045	JS	RIGHT MCA ANEURYSM	5.9*2.8*1.9	SMALL	SACCULAR
17	1433843	PK	RIGHT PCA P3	2.3*2.4*2.0	SMALL	SACCULAR
18	1445557	PK	RIGHT ICA ANEURYSM	6.6*3.8*2.2 mm	SMALL	SACCULAR
19	1443847	LS	LEFT ACA ANEURYSM	3.2*2.5*3.1	SMALL	SACCULAR
20	1446767	CD	RUPTURED PCOM	5.1*4.1*2.7	SMALL	SACCULAR
21	1443289	RK	LEFT ICA SUPRACLINOID SEGMENT, BASILAR TOP UNRUP	5.2*3.2*2.9	SMALL	SACCULAR BILOBED
22	1454675	R	LEFT ACA ANEURYSM	0.2*0.3*0.3 cm	SMALL	SACCULAR
23	1453968	KD	LEFT ACA ANEURYSM	6.6*4.8*2.2 mm	SMALL	SACCULAR
24	1457386	SS	RIGHT VERTEBRAL ARTERY	4.2"4.1"2.8MM	SMALL	SACCULAR
25	1468420	AK	RIGHT DACA ANEURYSM	6.5*4.5*4.0MM	SMALL	SACCULAR BILOBED
26	1470424	PK	ACOM ANEURYSM	2.8*1.9*2.6MM	SMALL	SACCULAR
27	1478517	KD	RIGHT. VERTEBRAL ARTERY ANEURYSM	4.4*2.9*3.8MM	SMALL	SACCULAR
28	1491728	GD	LEFT ICA SUPRACLINOID SEGMENT	22.5*19.5*3.7MM	LARGE	SACCULAR
29	707291	VC	RIGHT PCA P4	3.3*2.4*1.0MM	SMALL	SACCULAR
30	1537399	BL	RIGHT ICA SUPRACLINOID, LEFT ICA CAVERNOUS, LEFT CLINOID ICA	27*24*1.5MM, 9.2*9.6*2.1MM, 12*11*2.8MM	SMALL	SACCULAR
31	1545574	SS	RIGHT ICA ANEURYSM	3.8*1.9*1.8MM	SMALL	SACCULAR
32	1546978	VR	RIGHT MCA BIFURCATION	4.5*2.7*2.0MM	SMALL	SACCULAR
33	1559491	NN	ACOM ANEURYSM	5*4.4*2.5	SMALL	SACCULAR
34	1566924	DK	RT.ICA (COMMUNICATING SEGMENT), RT.ICA INTRACAVERNOUS .UNRUP	1.27*0.91*0.6CM	SMALL	SACCULAR
35	1577224	KD	LEFT ACA A4	4.4*3.2*2.4	SMALL	SACCULAR
36	1570548	KS	ACOM ANEURYSM	7.5*4*2.6MM	SMALL	SACCULAR
37	1591240	CK	ACOM ANEURYSM	4.6*5.7*4.5MM	SMALL	SACCULAR
38	1593537	JS	RIGHT MCA BIFURCATION	4.5*3.5*2.9MM	SMALL	SACCULAR
39	1604984	RK	ACOM ANEURYSM	6.0*2.0*1.5MM	SMALL	SACCULAR
40	1613481	KK	LEFT ACA A2 ANEURYSM	3.0*1.0*1.0MM	SMALL	SACCULAR
41	1628875	RK	RUPTURED ACOM ANEURYSM WITH UNRUPTURED DACA	0.6*0.5*0.36 CM	SMALL	SACCULAR
42	1632106	PK	LEFT ICA ANEURUSM DISTAL TO CAVERNOUS SEGMENT	7.8*7.9*7.2MM	SMALL	SACCULAR
43	1632721	BS	ACOM ANEURYSM	5*4.4*2.5	SMALL	SACCULAR
44	1639998	GS	LEFT A3 ACA ANEURYSM	2.3*2.4*1.0MM	SMALL	SACCULAR
45	1659297	MK	LEFT A1, A2 JUNCTION ANEURYSM	6.7*5.6*2.4MM	SMALL	SACCULAR
46	1662439	MK	ACOM ANEURYSM	2.0*2.7*1.4MM	SMALL	SACCULAR
47	1659649	GK	LEFT VERTEBRAL ARETERY ANEURYSM	1.6*2.0*1.7MM	SMALL	SACCULAR
48	1663968	JS	RIGHT SUPRACLINOID ICA ANEURYSM	5.3*4.3*1.7MM	SMALL	SACCULAR

S No.	MRD No.	Initials	Number of Aneurysm	Location of aneurysm	Hunt & Hess Grade	Mod. Fisher Grade	WFNS	GCS	GCS	EC BALLOON	EC FD	EC STENT
1	1307244	SR	2	MCA	GRADE 3	GRADE 2	GRADE 4	5	E1V1M3	YES	NO	NO
2	1326746	JS	1	ACOM	GRADE 3	GRADE 3	GRADE 4	9	E3V3M3	NO	NO	NO
3	1330280	DS	1	ACOM	GRADE 5	GRADE 4	GRADE 4	2	E1VETM1	YES	NO	NO
4	1329072	SS	1	ACOM	GRADE 4	GRADE 2	GRADE 4	9	E2V2M5	NO	NO	NO
5	1363626	LS	1	ACOM	GRADE 2	GRADE 2	GRADE 2	10	E4V1M5	NO	NO	NO
6	1368424	SD	1	ACOM	GRADE 3	GRADE 2	GRADE 3	9	E2V2M5	NO	NO	NO
7	1373975	JS	1	ACOM	GRADE 3	GRADE 4	GRADE 3	13	E3V4M6	NO	NO	NO
8	1373996	SD	2	ACA	GRADE 2	GRADE 1	GRADE 1	15	E4V5M6	NO	NO	NO
9	1386470	BS	1	ACOM	GRADE 3	GRADE 4	GRADE 4	9	E2V2M5	NO	NO	NO
10	1388466	SD	1	ACOM	GRADE 3	GRADE 2	GRADE 4	7	E1V2M4	NO	NO	NO
11	1398364	KS	1	ACOM	GRADE 2	GRADE 2	GRADE 3	13	E3V4M6	NO	YES	NO
12	1398350	GS	1	ACOM	GRADE 2	GRADE 2	GRADE 2	14	E3V5M6	NO	NO	NO
13	1403204	RS	1	ACOM	GRADE 2	GRADE 2	GRADE 2	14	E3V5M6	NO	NO	YES
14	1470596	RPS	1	ACA	GRADE 3	GRADE 4	GRADE 4	11	E3V3M5	NO	NO	NO
15	1416426	RS	1	ACOM	GRADE 2	GRADE 2	GRADE 2	12	E3V3M6	NO	NO	NO
16	1417045	JS	1	MCA	GRADE 2	GRADE 2	GRADE 1	15	E4V5M6	NO	NO	NO
17	1433843	PK	1	PCA	GRADE 2	GRADE 2	GRADE 1	15	E4V5M6	NO	NO	NO
18	1445557	PK	1	ICA	GRADE 2	GRADE 2	GRADE 1	15	E4V5M6	NO	NO	NO
19	1443847	LS	1	ACA	GRADE 3	GRADE 4	GRADE 2	14	E4V4M6	NO	NO	NO
20	1446767	CD	1	PCOM	GRADE 1	GRADE 2	GRADE 1	15	E4V5M6	NO	NO	NO
21	1443289	RK	2	ICA	GRADE 3	GRADE 3	GRADE 4	9	E2V2M5	NO	NO	NO
22	1454675	R	1	ACA	GRADE 1	GRADE 4	GRADE 3	13	E3V4M6	NO	NO	YES
23	1453968	KD	2	ACA	GRADE 2	GRADE 3	GRADE 1	15	E4V5M6	NO	NO	NO
24	1457386	SS	1	VA	GRADE 2	GRADE 3	GRADE 1	15	E4V5M6	NO	NO	NO
25	1468420	AK	1	ACA	GRADE 1	GRADE 2	GRADE 2	14	E3V5M6	NO	NO	NO
26	1470424	PK	1	ACOM	GRADE 2	GRADE 1	GRADE 1	15	E4V5M6	NO	NO	NO
27	1478517	KD	1	VA	GRADE 3	GRADE 2	GRADE 1	15	E4V5M6	NO	NO	YES
28	1491728	GD	1	ICA	GRADE 2	GRADE 1	GRADE 1	15	E4V5M6	NO	YES	NO
29	707291	VC	1	PCA	GRADE 2	GRADE 2	GARDE 1	15	E4V5M6	NO	NO	NO
30	1537399	BL	3	ICA	GRADE 2	GRADE 1	GRADE 1	15	E4V5M6	NO	NO	NO
31	1545574	SS	1	ICA	GRADE 4	GRADE 2	GRADE 4	5	E2V1M2	NO	NO	NO
32	1546978	VR	1	MCA	GRADE 4	GRADE 4	GRADE 4	9	E3V1M5	NO	NO	NO
33	1559491	NN	1	ACOM	GRADE 1	GRADE 2	GRADE 1	15	E4V5M6	YES	NO	NO
34	1566924	DK	2	ICA	GRADE 2	GRADE 1	GRADE 2	13	E3V4M6	NO	NO	NO
35	1577224	KD	1	ACA	GRADE 2	GRADE 1	GRADE 1	15	E4V5M6	NO	NO	NO
36	1570548	KS	1	ACOM	GRADE 3	GRADE 4	GRADE 4	8	E2V2M4	NO	NO	NO
37	1591240	CK	1	ACOM	GRADE 1	GRADE 1	GRADE 1	15	E4V5M6	YES	NO	NO
38	1593537	JS	1	MCA	GRADE 1	GRADE 2	GRADE 1	15	E4V5M6	YES	NO	NO
39	1604984	RK	1	ACOM	GRADE 2	GRADE 1	GRADE 1	15	E4V5M6	NO	NO	NO
40	1613481	KK	1	ACA	GRADE 1	GRADE 1	GRADE 1	15	E4V5M6	NO	NO	NO
41	1628875	RK	2	ACOM	GRADE 2	GRADE 1	GRADE 4	8	E2VETM4	NO	NO	NO
42	1632106	PK	1	ICA	GRADE 1	GRADE1	GRADE 1	15	E4V5M6	YES	NO	NO
43	1632721	BS	1	ACOM	GRADE 1	GRADE 1	GRADE 2	14	E4V4M6	NO	NO	NO
44	1639998	GS	1	ACA	GRADE 1	GRADE 1	GRADE 1	15	E4V5M6	NO	NO	NO
45	1659297	MK	1	ACOM	GRADE 1	GRADE 2	GRADE 1	15	E4V5M6	YES	NO	NO
46	1662439	MK	1	ACOM	GRADE 1	GRADE 2	GRADE 1	15	E4V5M6	NO	NO	NO
47	1659649	GK	1	VA	GRADE 3	GRADE 2	GRADE 4	8	E2VETM5	NO	NO	NO
48	1663968	JS	1	ICA	GRADE 2	GRADE 2	GRADE 1	15	E4V5M6	NO	NO	NO

S No.	MRD No.	Initials	HCP	MENINGITIS	NEUROLOGICAL DEFICIT post op	OTHERS	Post-op Vasospasm	Post-op intra-arterial nimodipine instillation
1	1307244	SR	YES	NO	NO	HYDROCEPHALUS	YES	NO
2	1326746	JS	YES	NO	NO	HYDROCEPHALUS	NO	NO
3	1330280	DS	YES	YES	NO	HYDROCEPHALUS , MENINGITIS	YES	NO
4	1329072	SS	NO	NO	NO	NO	NO	NO
5	1363626	LS	NO	NO	NO	NO	NO	NO
6	1368424	SD	NO	YES	NO	MENINGITIS	YES	NO
7	1373975	JS	NO	YES	NO	MENINGITIS	YES	NO
8	1373996	SD	NO	NO	NO	NO	NO	NO
9	1386470	BS	NO	NO	NO	NO	NO	NO
10	1388466	SD	NO	NO	NO	NO	NO	NO
11	1398364	KS	YES	NO	NO	HYDROCEPHALUS	YES	NO
12	1398350	GS	NO	NO	YES	RT UL , LT LL PARESIS	YES	NO
13	1403204	RS	NO	NO	YES	RT. HEMIPLEGIA	YES	NO
14	1470596	RPS	NO	NO	NO	LT.HEMIPLEGIA	YES	NO
15	1416426	RS	NO	NO	YES	SEIZURE	YES	NO
16	1417045	JS	NO	NO	YES	LEFT HEMIPARESIS	YES	NO
17	1433843	PK	NO	NO	NO	NO	NO	NO
18	1445557	PK	NO	NO	NO	NO	NO	NO
19	1443847	LS	NO	NO	YES	LT.LL PARESIS	YES	NO
20	1446767	CD	NO	NO	NO	NO	NO	NO
21	1443289	RK	NO	NO	YES	RIGHT HEMIPARESIS	YES	NO
22	1454675	R	NO	NO	YES	RIGHT LL HEMIPARESIS	YES	NO
23	1453968	KD	NO	NO	YES	LEFT HEMIPLEGIA	YES	NO
24	1457386	SS	NO	NO	NO	NO	NO	NO
25	1468420	AK	NO	NO	NO	NO	NO	NO
26	1470424	PK	NO	NO	NO	NO	NO	NO
27	1478517	KD	NO	NO	NO	NO	NO	NO
28	1491728	GD	NO	NO	NO	NO	NO	NO
29	707291	VC	NO	NO	YES	YES	NO	NO
30	1537399	BL	NO	NO	NO	NO	NO	NO
31	1545574	SS	NO	NO	YES	LEFT HEMIPARESIS	NO	NO
32	1546978	VR	NO	NO	YES	LEFT HEMIPLEGIA	NO	NO
33	1559491	NN	NO	NO	NO	NO	NO	NO
34	1566924	DK	NO	NO	NO	NO	NO	NO
35	1577224	KD	NO	NO	NO	NO	NO	NO
36	1570548	KS	NO	NO	NO	NO	NO	NO
37	1591240	CK	NO	NO	NO	NO	NO	NO
38	1593537	JS	NO	NO	YES	LEFT HEMIPARESIS	YES	NO
39	1604984	RK	NO	NO	YES	LEFT HEMIPARESIS	YES	NO
40	1613481	KK	NO	NO	NO	NO	NO	NO
41	1628875	RK	NO	NO	NO	NO	NO	NO
42	1632106	PK	NO	NO	NO	NO	NO	NO
43	1632721	BS	NO	NO	YES	RIGHT HEMIPARESIS	YES	NO
44	1639998	GS	NO	NO	NO	NO	NO	NO
45	1659297	MK	NO	NO	NO	NO	NO	NO
46	1662439	MK	NO	NO	NO	NO	NO	NO
47	1659649	GK	NO	NO	NO	YES	YES	NO
48	1663968	JS	NO	NO	YES	LEFT HEMIPARESIS	YES	YES

S No.	MRD No.	Initials	Post-op CT scan	Post-op CT Angiography	Post-op Hydrocephalus	Need for VP Shunt post-op	Need for EVD post-op
1	1307244	SR	RESOLVING SAH WITH LEFT PCA INFARCT	YES	YES	YES	NO
2	1326746	JS	RESOLVING INTRA PARENCHYMAL HMRAGE WITH DIFFUSE CEREBRAL ODEMA	YES	YES	YES	NO
3	1330280	DS	RESOLVING SAH AND IVH WITH HCP	YES	YES	YES	YES
4	1329072	SS	RESOLVING SAH AND IVH	YES	NO	NO	NO
5	1363626	LS	RESOLVING SAH WITH BL ACA INFARCT	YES	NO	NO	NO
6	1368424	SD	IVH	YES	NO	NO	NO
7	1373975	JS	RESOLVED SAH WITH IVH SDH	YES	NO	NO	NO
8	1373996	SD	NORMAL	YES	NO	NO	NO
9	1386470	BS	RESOLVED SAH WITH IVH	YES	NO	NO	NO
10	1388466	SD	RESOLVING ICH	YES	NO	NO	NO
11	1398364	KS	RESOLVING SAH	YES	YES	NO	YES
12	1398350	GS	RESOLVING IVH, HYPODENSE AREA IN LT,FRONTAL LOBE	YES	YES	NO	YES
13	1403204	RS	RESOLVING SAH IVH AND CONTUSIONS WITH INFARCT IN LT FP REGION	YES	NO	NO	NO
14	1470596	RPS	RESOLVING SAH WITH IVH	YES	YES	NO	YES
15	1416426	RS	RESOLVING SAH	YES	NO	NO	NO
16	1417045	JS	RT.MCA AND PCA TERRITORY INFARCT	YES	NO	NO	NO
17	1433843	PK	RESOLVING RT. THALAMIC BLEED WITH IVH	YES	NO	NO	NO
18	1445557	PK	RESOLVING IVH	YES	NO	NO	NO
19	1443847	LS	RESOLVING SAH AND IVH	YES	NO	NO	NO
20	1446767	CD	RESOLVING SAH WITH IVH	YES	NO	NO	NO
21	1443289	RK	RESOLVING SAH	YES	NO	NO	NO
22	1454675	R	RESOLVING SAH AND IVH	YES	NO	NO	NO
23	1453968	KD	RESOLVING SAH WITH INFARCT	YES	NO	NO	NO
24	1457386	SS	PERSISTANT AREA OF PONTINE HAEMORAGHE	YES	NO	NO	NO
25	1468420	AK	RESOLVING SAH	YES	NO	NO	NO
26	1470424	PK	RESOLVIG SAH	YES	NO	NO	NO
27	1478517	KD	RESOLVING SAH	YES	NO	NO	NO
28	1491728	GD	NO SAH AND IVH	YES	NO	NO	NO
29	707291	VC	RESOLVING IVH WITH RIGHT PO INFARCT	NO	NO	NO	NO
30	1537399	BL	RESOLEVD SAH	YES	NO	NO	NO
31	1545574	SS	RESOLVING SAH AND IVH	YES	NO	NO	NO
32	1546978	VR	RESOLVING SAH AND IVH	YES	NO	NO	NO
33	1559491	NN	RESOLVED SAH AND IVH	YES	NO	NO	NO
34	1566924	DK	RESOLVING SAH	YES	NO	NO	NO
35	1577224	KD	RESOLVING INTRA PARENCHYMAL BLEED	YES	NO	NO	NO
36	1570548	KS	RESOLVING SAH WITH IVH	YES	NO	NO	NO
37	1591240	CK	RESOLVED SAH	YES	NO	NO	NO
38	1593537	JS	RESOLVING SAH WITH PERSISTENT IVH	YES	NO	NO	NO
39	1604984	RK	RESOLVED SAH	YES	NO	NO	NO
40	1613481	KK	ARTEFACT	YES	NO	NO	NO
41	1628875	RK	RESOLVING SAH	YES	NO	NO	NO
42	1632106	PK	RESOLVING SAH	YES	NO	NO	NO
43	1632721	BS	RESOLVING SAH WITH RT.CEREBELLAR AND CEREBRAL SUBACUTE INFARCTS	YES	NO	NO	NO
44	1639998	GS	PERSISTANT HYPERDENSE AREA OF INTRAPARENCHYMAL HAEMORAGHE	YES	NO	NO	NO
45	1659297	MK	RESOLVING SAH WITH IVH	YES	NO	NO	NO
46	1662439	MK	SUBTLE SAH WITH PERSISTENT IVH	YES	NO	NO	NO
47	1659649	GK	INTERVAL REDUCTION IN SAH AND IVH	YES	NO	NO	NO
48	1663968	JS	RESOLVING SAH WITH PERSISTENT IVH	YES	NO		NO

S No.	MRD No.	Initials	Need for Decompression Craniectomy post - coiling	Development of infarct in post-op CT scan	Follow up GCS at discharge	Follow up after 2 months	OUTCOME	GOS	No.of coils used
1	1307244	SR	NO	YES	10	11	POOR	3	2
2	1326746	JS	NO	NO	15	15	GOOD	5	3
3	1330280	DS	NO	NO	6	6	POOR	3	2
4	1329072	SS	NO	NO	15	15	GOOD	5	4
5	1363626	LS	NO	YES	11	11	POOR	3	2
6	1368424	SD	NO	NO	15	15	GOOD	4	2
7	1373975	JS	NO	NO	15	15	GOOD	5	1
8	1373996	SD	NO	NO	15	15	GOOD	5	5
9	1386470	BS	NO	NO	15	15	GOOD	5	4
10	1388466	SD	NO	NO	15	15	GOOD	5	3
11	1398364	KS	NO	NO	15	15	GOOD	4	2
12	1398350	GS	NO	NO	14	14	GOOD	4	6
13	1403204	RS	NO	YES	15	15	POOR	3	6
14	1470596	RPS	NO	NO	9	9	POOR	3	3
15	1416426	RS	NO	NO	15	15	GOOD	5	2
16	1417045	JS	YES	YES	15	15	POOR	3	3
17	1433843	PK	NO	NO	15	15	GOOD	4	3
18	1445557	PK	NO	NO	15	15	GOOD	4	3
19	1443847	LS	NO	NO	15	15	GOOD	5	3
20	1446767	CD	NO	NO	15	15	GOOD	4	1
21	1443289	RK	YES	YES	12	12	POOR	3	4
22	1454675	R	NO	NO	15	15	GOOD	5	3
23	1453968	KD	NO	YES	15	15	POOR	3	4
24	1457386	SS	NO	NO	15	15	GOOD	4	3
25	1468420	AK	NO	NO	15	15	GOOD	5	5
26	1470424	PK	NO	NO	15	15	GOOD	5	1
27	1478517	KD	NO	NO	15	15	GOOD	5	4
28	1491728	GD	NO	NO	15	15	GOOD	5	1
29	707291	VC	NO	YES	15	15	POOR	1	6
30	1537399	BL	NO	NO	15	15	GOOD	5	1
31	1545574	SS	NO	NO	15	15	GOOD	4	1
32	1546978	VR	NO	NO	9	9	POOR	2	2
33	1559491	NN	NO	NO	15	15	GOOD	4	2
34	1566924	DK	NO	NO	15	15	GOOD	5	4
35	1577224	KD	NO	NO	15	15	GOOD	5	4
36	1570548	KS	NO	NO	15	15	GOOD	4	1
37	1591240	CK	NO	NO	15	15	GOOD	5	3
38	1593537	JS	NO	YES	15	15	POOR	2	4
39	1604984	RK	NO	NO	15	15	GOOD	5	4
40	1613481	KK	NO	NO	15	15	GOOD	5	4
41	1628875	RK	NO	NO	15	15	GOOD	4	10
42	1632106	PK	NO	NO	15	15	GOOD	4	6
43	1632721	BS	NO	YES	15	15	POOR	3	2
44	1639998	GS	NO	NO	15	15	GOOD	5	3
45	1659297	MK	NO	NO	15	15	GOOD	4	5
46	1662439	MK	NO	NO	15	15	GOOD	4	2
47	1659649	GK	NO	NO	14	14	POOR	2	3
48	1663968	JS	NO	YES	15	15	POOR	2	5

S No.	MRD No.	Initials	Duration of operation MINUTES	Hb	TLC	DLC	S.BIL	SGOT	SGPT	ALP	UREA	CREAT	SODIUM	POT.	INR	FBS
1	1307244	SR	90	11	7.7	67/22/8	0.8	20	10	4.18	38	0.57	137	4.27	12.7/1.16	177
2	1326746	JS	60	11.1	10.4	72/18/7	0.6	31	26	253	39	0.53	132	3.27	13.6/1.24	114
3	1330280	DS	40	8.6	13.6	70/16/8	1	35	28	150	28	0.73	140	3.45	12.6/1.26	110
4	1329072	SS	120	10	2.81	64/23/9	0.6	24	30	144	24	0.63	133	4.02	13/1.26	108
5	1363626	LS	45	10.6	4.4	64/21/10	0.88	40	41	124	26	0.89	138	4.28	13.1/1.24	158
6	1368424	SD	50	11	6.6	56/35/6	0.5	32	39	87	20	1.61	136	4.28	12.8/1.17	204
7	1373975	JS	60	13	7.3	55/32/10	0.88	39	40	128	30	0.53	146	3.39	11.8/1.12	156
8	1373996	SD	50	9.3	6.53	71/21/5	0.86	40	39	126	32	0.54	133	4.52	10.6/1.14	136
9	1386470	BS	80	10.4	4.5	58/27/9.7	0.86	39	41	139	30	0.76	128	4.44	12.6/1.11	132
10	1388466	SD	60	12.2	5.35	32/9/02	0.58	33	38	121	47	0.65	138	4.02	12.2/1.24	110
11	1398364	KS	105	8.6	2.2	50/38/10	1.52	151	296	278	45	1.25	140	4.28	10.6/1.26	108
12	1398350	GS	45	11.9	6.86	64/26/5	0.88	69	38	122	22	1.2	126	3.38	10.0/1.20	118
13	1403204	RS	130	11	8.4	63/23/9	0.98	38	39	128	29	0.79	120	3.45	10.6/1.20	128
14	1470596	RPS	80	12	3.9	54/35/10	0.68	45	12	119	45	0.69	138	3.32	12.8/1.22	155
15	1416426	RS	60	9	8.6	61/26/10	0.58	44	10	110	24	0.64	130	3.28	10.9/1.1	128
16	1417045	JS	50	11	9.3	70/26/10	0.85	46	36	156	45	0.35	140	3.67	11.2/1.23	102
17	1433843	PK	45	11.5	12.6	60/10/5	0.88	45	18	132	44	0.45	136	3.8	12.2/1.3	145
18	1445557	PK	60	11.2	10.8	68/36/10	0.65	42	22	115	18	0.32	132	34	11.9/1.2	115
19	1443847	LS	60	10.3	10.6	60/35/9	0.75	30	30	145	30	0.86	135	3.2	12.8/1.33	111
20	1446767	CD	55	11.6	6.6	80/12/10	0.78	36	36	160	38	0.56	138	4.2	10.9/1.03	143
21	1443289	RK	85	9.9	5.8	60/18/6	0.77	35	16	114	35	0.78	139	3.6	11.4/1.23	137
22	1454675	R	135	11.6	12	58/14/5	0.54	45	20	108	16	1	135	3.5	11.8/1.3	156
23	1453968	KD	45	12	11.6	55/18/10	0.86	44	30	165	22	0.24	132	3.7	12.4/1.32	140
24	1457386	SS	40	11.8	10.8	50/16/5	0.84	30	26	116	14	0.61	137	3.4	13.1/1.5	118
25	1468420	AK	90	10.8	16.6	60/18/6	0.95	38	28	152	22	0.92	142	3.9	11.8/1.4	120
26	1470424	PK	50	12.6	6.6	58/19/6	0.98	42	26	133	28	0.45	136	3.85	12.1/1.3	123
27	1478517	KD	30	12	10	56/18/10	0.85	45	22	140	26	0.36	140	3.6	10.8/1.09	142
28	1491728	GD	110	13	9.9	62/15/9	0.88	39	30	143	28	0.65	139	3.9	11.2/1.21	145
29	707291	VC	45	10.5	8.6	60/18/5	0.86	34	29	156	23	0.45	137	4.2	12.6/1.32	95
30	1537399	BL	55	10.4	4.4	56/15/6	0.84	36	28	180	34	0.9	135	3.4	12.7/1.41	165
31	1545574	SS	60	10	6	58/14/5	0.74	41	24	122	38	0.94	136	3.6	11.6/1.36	132
32	1546978	VR	80	12.2	12.6	68/15/6	0.65	45	26	165	36	0.56	137	3.9	12.7/1.38	120
33	1559491	NN	85	13	11.6	66/14/7	0.86	40	24	120	34	0.78	136	4.5	11.1/1.2	114
34	1566924	DK	60	12.6	18.8	66/18/6	0.66	36	25	154	36	0.63	142	3.8	11.5/1.23	112
35	1577224	KD	55	11.8	12.2	70/18/5	1.1	38	25	152	40	0.87	136	4.2	11.8/1.25	108
36	1570548	KS	45	12.3	11.6	68/15/10	0.86	36	26	162	48	0.66	133	4.1	11.8/1.25	190
37	1591240	CK	75	10.5	11	70/14/6	0.45	40	30	120	46	0.54	139	4.5	10.8/1.12	130
38	1593537	JS	95	10.6	10.8	74/18/9	1.8	45	18	150	50	0.88	140	3.7	12.9/1.38	120
39	1604984	RK	60	11.2	12.8	72/16/10	0.9	42	16	145	24	1.1	135	3.6	13.2/1.41	154
40	1613481	KK	60	11.6	11	70/16/5	0.56	35	17	165	38	0.23	136	3.8	12.8/1.39	123
41	1628875	RK	45	11.9	12.6	63/14/5	0.88	36	18	145	30	0.69	137	3.5	11.2/1.40	112
42	1632106	PK	105	12.3	13	62/17/6	1.5	38	25	146	34	0.56	139	4.2	12.8/1.41	96
43	1632721	BS	90	13.2	13.8	60/16/7	0.5	30	26	156	36	0.57	140	3.9	11.5/1.32	104
44	1639998	GS	60	10.8	14.5	55/12/8	0.66	28	28	125	34	0.63	135	4.5	11.67/1.38	150
45	1659297	MK	80	11.5	12.5	60/12/4	0.86	50	22	135	36	0.25	142	3.7	12.4/1.5	124
46	1662439	MK	70	12.3	12.6	68/14/6	0.45	46	16	140	33	0.56	141	4.8	12.1/1.38	123
47	1659649	GK	35	12.6	11	68/14/10	1.2	45	29	165	35	0.54	139	4.2	11.7/1.45	140
48	1663968	JS	45	11.8	6.6	72/15/6	0.55	42	25	143	36	1.2	138	4.3	12.7/1.43	102

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The Principal
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Subject:: Approval of Plan of Thesis.

This is to inform you that the Faculty of Medical Sciences in its meeting held on 25.09.2023 has approved the plan of thesis of **Saurav Mittal**, a student of your college for **MCh Neuro-Surgery** along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis
To evaluate the outcome of endovascular coiling in patients with ruptured intracranial aneurysms .

Supervisor
Dr. Ashwani K Chaudhary
Prof. & Head
Dept. of Neuro-Surgery

Co-Supervisor:-
Dr. Shivender Sobti
Professor
Dept. of Neuro-Surgery.

The student may submit the thesis in triplicate alongwith the plan in triplicate also, to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She may be directed to attach a photocopy of this letter with the forwarding letter while submitting thesis in the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic, if any.

Controller of Examinations

Note :

1. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*

TO EVALUATE THE OUTCOME OF ENDOVASCULAR COILING IN PATIENTS WITH RUPTURED INTRACRANIAL ANEURYSMS

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

M.Ch.
In
NEUROSURGERY

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES
FARIDKOT

OCTOBER, 2022

DR. SAURAV MITTAL

DEPARTMENT OF NEUROSURGERY
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	TO EVALUATE THE OUTCOME OF ENDOVASCULAR COILING IN PATIENTS WITH RUPTURED INTRACRANIAL ANEURYSMS
For the degree of	M.Ch. Neurosurgery
Name of the candidate	Dr. Saurav Mittal
Supervisor	Dr. Ashwani K Chaudhary, Professor and Head, Department of Neurosurgery, DMCH, Ludhiana
Co-supervisor	Dr. Shivender Sobti, Professor, Department of Neurosurgery, DMCH, Ludhiana
Institution	Dayanand Medical College & Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

INTRODUCTION: Intracranial aneurysm is an abnormal focal dilation of an artery in the brain that results from a weakening of the inner muscular layer of a blood vessel wall. Approximately 85% of aneurysms are located in the anterior circulation, predominantly at junctions or bifurcations along the circle of Willis. Various risk factors includes age over 40 years, female, hypertension, smoking, head injury, alcohol/drug abuse, family history of aneurysm. Complications may include vasospasm, hydrocephalus, seizures, rebleeding. The treatment modalities include surgical clipping and endovascular coiling.

AIMS AND OBJECTIVES: To evaluate the outcome of endovascular coiling in patients with ruptured intracranial aneurysms.

MATERIALS AND METHODS: The study will be conducted among the patients admitted to Department of Neurosurgery, Dayanand Medical College and Hospital, Ludhiana from 1st November 2022- 31st January 2024. Data shall be collected through a pre-designed proforma for each patient with detailed history, clinical examination and complete investigational workup. A pre-informed consent from each patient shall be taken. Details of the study will be explained to each patient. Analysis will be done with the collected data prospectively.

CLINICAL SIGNIFICANCE: This prospective study will help to evaluate the outcome of endovascular coiling in patients with intracranial aneurysms.

KEYWORDS: intracranial aneurysm, endovascular coiling.

(Signature)	(Signature)	(Signature)	(Signature)
Candidate	Co-supervisor	Supervisor	Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"TO EVALUATE THE OUTCOME OF ENDOVASCULAR COILING IN PATIENTS WITH RUPTURED INTRACRANIAL ANEURYSMS"** exist in the Department of Neurosurgery, Dayanand Medical College, Ludhiana & will be provided to the candidate. We will see that the data being included in the thesis are genuine & is collected by the candidate himself under our supervision & guidance.

Supervisor

Dr. Ashwani K Chaudhary
Professor and Head
Department of Neurosurgery
Dayanand Medical College & Hospital
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Co-Supervisor

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Head of the Department

Dr Ashwani K Chaudhary
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Place: Ludhiana

Date:

APPROVAL PROFORMA BY
RESEARCH & ETHICAL COMMITTEE
DAYANAND MEDICAL COLLEGE & HOSPITAL,
LUDHIANA

Name of candidate	Dr. Saurav Mittal
Department	Neurosurgery
Topic of Thesis	TO EVALUATE THE OUTCOME OF ENDOVASCULAR COILING IN PATIENTS WITH RUPTURED INTRACRANIAL ANEURYSMS
Likely date of appearing in PG examination	May/June 2025
Date of enrollment	30th April 2022
Name of Head of Department	Dr. Ashwani K Chaudhary
1) Supervisor **2) Co-Supervisor**	Dr. Ashwani K Chaudhary Dr. Shivender Sobti
Signature of Members of Research Committee with Stamp	**Signature of Members of Ethics Committee with Stamp**
Dr. Harpreet Kaur (Professor & Head, Pathology)	Mr. R K Sharma (Legal Expert)
Dr. Jaspal Singh (Professor & Head, Surgery)	Dr. Ramit Mahajan (Associate Professor, Gastroenterology)
Dr. Dinesh Gupta (Professor & Head, Medicine)	Dr. Anu Sharma (Professor, Anatomy)
Dr. Sandeep Kaushal (Dean Academics & Professor & Head, Pharmacology)	Dr. Sandeep Kaushal (Dean Academics & Professor & Head, Pharmacology)
Dr. Gurpreet S Wander (Vice Principal)	Dr. Gurpreet S Wander (Vice Principal & Professor & Head, Cardiology)
	Dr. Gagandeep Singh (Secretary, Ethics Committee Professor & Head, Neurology)

Approved: Yes / ~~No~~

Dr. Sandeep Puri
Chairperson
Research Committee

Chairperson
Research Committee

Approved: Yes / No

Prof. Arvind Malhotra
Chairperson
Ethics Committee

Chairperson
Ethics Committee

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PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

1	NAME OF THE CANDIDATE AND ADDRESS	DR. SAURAV MITTAL #1411-A, Street No. 14, Gurbax Colony, Patiala
2	NAME OF THE INSTITUTE	DAYANAND MEDICAL COLLEGE AND HOSPITAL, LUDHIANA
3	COURSE OF STUDY AND SUBJECT	M.Ch NEUROSURGERY
4	DATE OF ADMISSION OF COURSE	30 April, 2022
5	TITLE OF THE TOPIC	TO EVALUATE THE OUTCOME OF ENDOVASCULAR COILING IN PATIENTS WITH RUPTURED INTRACRANIAL ANEURYSMS

6.0 BR IEF RESUME OF THE INTENDED WORK

6.1 NEED FOR STUDY

A cerebral or intracranial aneurysm is an abnormal focal dilation of an artery in the brain that results from a weakening of the inner muscular (the intima) of a blood vessel wall. The vessel develops a " blister-like" dilation that can become thin and rupture without warning. The resultant bleeding into the space between the skull and the brain called subarachnoid hemorrhage and sometimes into the brain tissue called intracerebral hemorrhage. This kind of hemorrhage can lead to a stroke , coma and/or death. The majority of cerebral aneurysms are silent and may be found incidentally on neuroimaging. Approximately 85% of aneurysms are located in the anterior circulation, predominantly at layerjunctions or bifurcations along the circle of Willis.[1]

Every year approximately 30,000 patients in the U.S. suffer from a ruptured cerebral aneurysm, and upto 6% of the population may have an un-ruptured cerebral aneurysm.[2] The prevalence of intracranial aneurysm is about 1-5% (10 million to 12 million persons in the United States) and the incidence is 1 per 10,000 persons per year in the United States, with 30 to 60 year old being the age group most affected.[3]

RISK FACTORS FOR ANEURYSM FORMATION [4]

There are several risk factors that can increase the risk of developing a brain aneurysm. These include:

Age: Most aneurysms are diagnosed in individuals who are over the age of 40.

Sex: Women are more likely to get aneurysms than men.

Have Family history of aneurysm.

High blood pressure

Smoking

Alcohol and drug misuse, specifically cocaine or amphetamine use.

Head injury

Genetic conditions including Autosomal dominant polycystic kidney disease, Ehlers- Danlos syndrome, Marfan syndrome

Congenital conditions like arteriovenous malformations or coarctation of aorta can also raise the risk of aneurysms.

RISK FACTORS FOR ANEURYSM RUPTURE [5]

Some aneurysms will never rupture. However, there are also risk factors that can increase the chance of a ruptured aneurysm.

Risk factors include:

- Smoking
- High blood pressure
- Size: The largest aneurysms are the ones most likely to rupture in a person who previously did not show symptoms.
- Location: Aneurysms located on the posterior communicating arteries and possibly those on the anterior communicating artery have a highe risk of rupturing than those located at other locations in the brain.
- A family history of aneurysm rupture suggests a higher risk of rupture for aneurysms detected in family members.
- The greatest risk occurs in individuals with multiple aneurysms who have already suffered a previous rupture or sentinel bleed.

SYMPTOMS

The symptoms and warning signs of brain aneurysm vary based on whether it has ruptured or not.

SYMPTOMS OF RUPTURED ANEURYSM [6]

- Sudden and extremely severe headache (the worst headache of one's life, sometimes called thunderclap headache)

-Neck stiffness -Blurry or double vision

-Sensitivity to light -Drooping eyelid

-Difficulty in speaking -Dizziness or trouble walking

-Nausea or vomiting -Seizures

-Mental confusion -Loss of consciousness

CLASSIFICATION OF ANEURYSMS [7]

According to size, Aneurysms are classified as:

- Small Aneurysms: less than 11mm in diameter
- Large Aneurysms: 11-25mm in diameter
- Giant aneurysms: greater than 25mm in diameter

Based on the type, there are three types of cerebral aneurysms:

- Saccular Aneurysm
- Fusiform Aneurysm
- Mycotic Aneurysm

COMPLICATIONS OF RUPTURED CEREBRAL ANEURYSM [8]

When the aneurysm leaks or bursts open, blood flows into or around the brain. The pooling blood irritates brain tissue, which can make the brain swell. The result can be permanent brain damage, stroke or other complications such as:

-Vasospasm - Hydrocephalus

-Rebleeding - Hyponatremia

-Seizures - Coma

-Arrythmias, congestive cardiac failure

DIAGNOSTIC MODALITIES

Several tests are available to diagnose brain aneurysms and determine the best treatment. These include:[9]

- Magnetic resonance imaging/ Magnetic resonance angiography
- Computed tomography/ CT angiography
- Digital subtraction angiography
- Lumbar puncture

GRADING[10]

- The first widely used scale for neurological condition following SAH was published by Botterell and Cannell in 1956 and referred to as Botterell Grading Scale. This was modified by Hunt and Hess in 1968.

- The Fisher grade classifies the appearance of subarachnoid hemorrhage on CT scan.
- The World Federation of Neurosurgeons (WFNS) classification uses Glasgow coma score and focal neurologic deficit to gauge severity of symptoms.

TREATMENT FOR BRAIN ANEURYSMS

Broadly, three treatment options for people with the diagnosis of cerebral aneurysm include:

- Medical therapy

-Surgical clipping

-Endovascular coiling

Goals of endovascular coiling:[11]

- Isolate an aneurysm from the normal circulation without blocking off any small arteries nearby or narrowing the main vessel.
- Prevention of rupture in unruptured aneurysm
- Prevention of rebleeding in ruptured aneurysms by limiting blood circulation to the aneurysm space.

The patients most suitable for endovascular coiling are those with aneurysms:[12]

- With a small neck size (preferably <4mm)
- With Luminal diameter <25mm
- That are distinct from the parent vessel

MECHANISM:

Endovascular coiling works by promoting blood clotting (thrombosis) in the aneurysm, eventually sealing it from the blood flow. This is accomplished by decreasing the amount of blood flow going into the aneurysm, increasing the residence time of the blood in the aneurysm space and reducing the wall shear stress of the aneurysm wall.[13]

CLINICAL OUTCOME:[14]

Based on the Glasgow Outcome Scale (GOS), the clinical outcome for endovascular coiling is as given:

- Score 1: Death
- Score 2: Persistent vegetative state
- Score 3: Severe disability
- Score 4: Moderate disability
- Score 5: Good recovery

REVIEW OF LITERATURE

A retrospective review of patients who had underwent endovascular coiling for symptomatic and asymptomatic cerebral aneurysm between 2011-2016 in Suez insurance hospital was performed. 35 aneurysms in 31 cases were included in this study. Males and females were almost equally distributed. The age ranges from 18-71 years, and hypertension was the most prevelant risk factor 13 patients (41.9%). Most of the patients were symptomatic 96.8% (30 patients) either presented with subarachnoid hemorrhage 28 patients (90.3%) or mass effect of 2 patients (6.5%). Only one patient was asymptomatic. According to Hunt and Hess scale, 10 patients (32.2%) were at grades 1 and 2, and on the other hand 21 patients (67.8%) were at grades 3 and 4. According to Fisher grading, 22 patients (71%) were at grades 1,2 and 9 patients (29%) were at grades 3 and 4. Five patients (16.1%) had vasospasm related infarction and five patients (16.1%) developed hydrocephalus necessitating shunt. 23 patients had good outcome (mRS= 0,1,2) and 8 patients had poor outcome (mRS= 3,4,5,6).[15]

In another study,3-year retrospective analysis was performed to assess the clinical and radiological outcome of patients with cerebral aneurysm treated with detachable coils in an asian population with relation to comorbidities including smoking and hypertension with age and gender as mediators. A total of 297 consecutive patients were included in the study. A modified Rankin scale was used to measure the clinical outcome in patients. The study had a near equal mix of males and females, with female patients being a majority (57.6%) of the total. The average age of the patient was 42 years with the majority of the patients being within the age range of 40-50 years old. It was found that smoking harmed clinical outcome, with smokers 35% less likely to recover, while hypertension played a smaller role with only 15%. Patients who were above the age 40

had a lower chance of recovery compared to younger patients due to comorbidities irrespective of gender.[16]

A 6-year study was conducted by Sharma DP, Singh D, Jagetia A, et al on 150 patients (77 males and 73 females). 168 aneurysms were coiled in 150 patients with the mean age 47 years. Eighteen of the patients had incidental unruptured aneurysms. Of the treated aneurysms, the size of the aneurysm was: medium (7-10mm) in 80(49%), large (12-15mm) in 45(26%), small (3-6mm) in 26(15%) and giant (>25mm) in 17(10%) patients.[17]

The study done by Tian Z, Liu J, Zhang Y, et al in the year 2014-2015 included 504 patients (219 males and 285 females) with 558 intracranial aneurysms. The mean age of the patient was 52.5+/-10.7 years. Of the 558 aneurysms, 228(40.9%) were ruptured and 330(59.1%) were unruptured. A total of 94(16.8%) aneurysms were an irregular shape. A total of 260(46.6%) aneurysms were treated by coiling alone and 298(53.4%) aneurysms by stent assisted coiling. Out of 558 aneurysms, 405(72.6%) were located in the anterior circulation and 153(27.4%) in the posterior circulation. 57/558 aneurysms showed recurrence. Aneurysm size (p= 0.028), therapy (p=0.008), the Raymond scale (p=0.040), aneurysm rupture status (p <0.001) showed significant associations with angiographic follow-up outcome.[18]

Alizada M, Fuyi Y, Mbori NJR, et al conducted a retrospective study on a total of 200 patients which were randomly divided into two groups, Group A (n=100) who were treated with surgical clipping and Group B (n=100) who were treated with endovascular coiling with female predominance (63%). Patients were evaluated pre-operatively with Hunt and Hess grade and Glasgow come score. Based on the modified Rankin score, the

clinical outcome for endovascular coiling was 73(73%) patients had good outcome, 22(22%) patients showed dependency and 5(5%) death.[19]

Park JH, Kim YI and Lim YC conducted a retrospective study in 2014 using the medical records of 159 elderly patients from September 2008 to December 2013. Obtained clinical information included age, sex, Hunt and Hess grade (HHG), aneurysm location, Fisher grade (FG) and the treatment modality. A total of 108 patients (67.9%) presented with subarachnoid hemorrhage (SAH), and 51 (32.1%) with unruptured intracranial aneurysms (UIAs). Coiling was performed in 101 patients and 58 patients underwent clipping. In the SAH population, 62 patients (57.4%) showed favorable outcomes, with a mortality rate of 11.3% (n = 18). In the UIAs population, 50 (98%) patients achieved 'excellent' and one (2%) achieved 'good' outcome. Factors including high-grade HHG ($p < 0.001$), advanced age ($p = 0.014$), and the presence of intraventricular hematoma (IVH) ($p = 0.017$) were significant predictors of poor outcome[20]

Pyysalo LM, keski-Nisula LH, Niskakangas TT et al conducted a study after endovascular treatment for intracranial aneurysm to assess the long-term clinical and angiographic outcome of patients with endovascularly treated aneurysms. The clinical outcome of all patients with endovascularly treated aneurysms were analyzed. Most surviving SAH patients were in good clinical condition after follow-up: 34 (57%) patients had a GOS score of 5, and 12 (20%) patients had a GOS score of 4. Thirteen patients (22%) were dependent (GOS score of 3) and one (2%) patient was vegetative. Four patients were lost to clinical outcome. A total of 31 (55%) patients with unruptured aneurysms had a GOS score of 5, and 16 (29%) patients had a GOS score of 4. Nine patients (16%) were dependent after 11 years of follow-up. Two patients with unruptured aneurysms were lost to clinical follow-up. Poor outcome in patients with unruptured aneurysms was related to aneurysm in only three patients.[21]

In another study conducted by Xavier AR, Abdelbaky A, Rayes M et al to determine Clinical and angiographic outcome in patients with completely occluded intracranial aneurysms by endovascular coiling 83 aneurysms were identified in 74 patients (15 men and 59 women, average age 52.4 years) with complete occlusion post intervention. Treatment by coiling only was used in 73 aneurysms while stent assisted coiling was used in 10 cases. At the last angiographic follow-up (mean 16.3 months), 20 of the 83 aneurysms demonstrated various degrees of recanalization of which five had neck remnants and 15 had body remnants. The recanalization rate was significantly higher in large aneurysms (57%) compared with small aneurysms (14%). Clinically, 65 of the 74 patients showed good recovery (GOS score 5), eight had moderate disability (GOS score 4) and one was severely disabled (GOS score 3).[22]

6.2 AIMS AND OBJECTIVES OF THE STUDY

To evaluate the outcome of endovascular coiling in patients with ruptured intracranial aneurysms.

7.0 MATERIALS AND METHODS

7.1 SOURCE OF DATA

Place of study:

The study will be conducted at Dayanand Medical College, Ludhiana in Department of Neurosurgery.

7.2 METHOD OF COLLECTION OF DATA

Inclusion criteria:

- All patients with ruptured Posterior circulation aneurysms
- All patients with ruptured Anterior circulation intracranial aneurysms without large ICH and mass effect.
- All patients consenting for procedure

Exclusion criteria:

- Patients with large intracerebral hematoma
- Patients who opt for surgical clipping
- Low GCS (WFNS Grade 5)

Pre-operative work-up will be carried out for all patients, which includes

- Complete history
- Clinical examination
- Standard laboratory investigations for the fitness of surgery that is Hb, BT, CT, TLC, DLC, FBS, Blood urea, Serum Creatinine, Serum Electrolytes, PTI, SGOT, SGPT,ALP,HBsAg, HCV, HIV.
- CT scan/ CT Angiography
- Pre-anesthetic checkup

Duration of study: The study will be carried out from 1st November 2022-31st January 2024.

Study design:

Observational study

OPERATIVE TECHNIQUE

Endovascular procedures will be performed in the special procedure room by the neurosurgeon under general anesthesia.

STEPS DURING THE PROCEDURE:

- The skin over the puncture site will be cleaned.
- A catheter will be inserted into the artery using a guide wire. The catheter will be guided through the blood vessel into the brain using fluoroscopy.
- Once the catheter has been guided to the affected artery in the brain, contrast dye will be injected to make the aneurysm and surrounding blood vessels visible on X-ray.
- The aneurysm will be measured and it's shape and other characteristics will be recorded.
- Next, a smaller catheter will be inserted into the initial catheter.
- Once the catheter has reached the aneurysm, the neurosurgeon will manipulate the coil into the aneurysm.
- When the coil has been completely inserted into the aneurysm, the coil is separated from the catheter.
- We will insert as many coils as needed to completely seal off the aneurysm. The coils will form a mesh-like structure inside the aneurysm.
- After the aneurysm has been packed with coils, additional X-ray images will be taken to make sure the aneurysm has been sealed off. The coil is left in place permanently in the aneurysm.
- Once the aneurysm has been sealed off, the catheter will be removed. After the insertion site bleeding stops, a dressing will be applied.
- After the procedure, patient will be taken to the recovery room or the ICU for observation.
- A nurse will monitor the vital signs, neurological signs, the insertion site and circulation or sensation in the affected leg.

- Dressing from puncture site will be removed after 48 hours.

OUTCOME:

Outcome will be evaluated by using Glasgow Outcome Scale at the time of discharge and two months after discharge.

STATISTICAL ANALYSIS:

Data will be described in terms of range, mean +/- SD, median, appropriate frequencies (number of cases) and relative frequencies (percentage) as. For comparing categorical data, Chi square test will be performed. A probability value (p value) less than 0.05 will be considered statistically significant. SPSS version 21.0 will be used for data analysis.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

NO

7.4 HAS ETHICAL CLEARENCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Attached herewith

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PROFORMA

Case No.

Name of the patient:

Patient's Demographics: Age Sex

MRD No.

Date of admission:

Date of Procedure:

Date of discharge:

Signs and Symptoms:

Headache	Pupils
Drooping eyelid	Seizures
Neck pain	GCS
Nausea/Vomiting	

Risk factors:

Hypertension	Smoking
Family history of Aneurysm	Alcohol/Drug misuse

GPE:

Systemic examination:

Signature of candidate **Signature of Supervisor**

Investigations:

Hb TLC

DLC Blood Urea

Serum Creatinine FBS

Serum Bilirubin Alkaline Phosphatase

SGOT SGPT

Serum Electrolyte PTI/INR

Pre-operative CSF diversion: Done Not done

Pre-operative CT scan/ CT Angiography:

Aneurysm Profile:

Size of Aneurysm:

Type of Aneurysm:

-Saccular

-Fusiform

Signature of candidate **Signature of Supervisor**

Number of aneurysm:

Location of aneurysm:

Pre-operative evaluation using:

-Hunt and Hess grade

-Fisher grade

-WFNS

-GCS

Operative findings

Type of procedure:

-Endovascular coiling alone

-Balloon or stent assisted

-Flow Diverter

No. of coils used:

Duration of operation:

Complications:

Post-operative Vasospasm:

Signature of candidate **Signature of Supervisor**

Post-operative intra-arterial nimodipine instillation: Yes/No

Post-operative CT/ CT Angiography findings:

Post-operative hydrocephalus: Yes/No

- Need for VP Shunt post-operatively

- Type of VP shunt used

- Need for EVD post-operatively

Need for Decompression Craniectomy post-coiling:

Development of infarct in post-operative in CT Scan:

Post-operative follow up :

-At discharge -After 2 months

Clinical outcome using GOS:

-Score 1: Death

-Score 2: Persistent vegetative state

-Score3: Severe disability

-Score 4: Moderate disability

-Score 5: Good recovery

Signature of candidate **Signature of Supervisor**

INFORMED PATIENT CONSENT

Date: _____

I…… D/o, W/o, S/o……. am willing to participate in the study **"TO EVALUATE THE OUTCOME OF ENDOVASCULAR COILING IN PATIENTS WITH RUPTURED INTRACRANIAL ANEURYSMS"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out of the study any time without assigning any reason.

……. ……

Signature of the Witness Signature of the patient

Name:

Signature of Candidate **Signature of Supervisor**

मरीजअनुमतिफार्म

तिथि_____

मैं_____ पत्नी/पुत्र/पुत्री_____

निवासी_____ इस शोधकार्य **"TO EVALUATE THE OUTCOME OF ENDOVASCULAR COILING IN PATIENTS WITH RUPTURED INTRACRANIAL ANEURYSMS"**में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छासे तैयार हूँ। मैं पुष्टि करता/ करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिकप्रलोभननहींदिया गया और नही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता /सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ _____

गवाह के हस्ताक्षर रोगी के हस्ताक्षर/अंगूठे का निशान

नाम: नाम:

_____

अन्वेषक केहस्ताक्षर

_____

विद्यार्थीकेहस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ_____

“TO EVALUATE THE OUTCOME OF ENDOVASCULAR COILING IN PATIENTS WITH RUPTURED INTRACRANIAL ANEURYSMS” ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾ ਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

_____ _____

ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ /ਪ੍ਰਤੀਨਿਧੀ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

_____

ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

_____

ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ